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Tank 241-T-111 Characterization Report

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EXECUTIVE SUMMARY

Single-shell tank 241-T-111 is a Hanford-Site High-Level Waste tank that was most recently sampled in late October and early November 1991. Analyses of materials obtained from tank 241-T-111 were conducted to support the Hanford Federal Facility Agreement and Consent Order[1] *(Tri-Party Agreement) Milestone M-10-06 (now M-44-05). The waste in tank 241-T-111 is a complex material primarily made up of water and inorganic salts in a gel-like matrix. The insoluble solids are a mixture of phosphates, silicates, oxides, and hydroxides in combination with lanthanum, calcium, manganese, iron, bismuth, uranium, and chromium. The soluble analytes are primarily sodium, nitrate, sulfate, and fluoride (see Table ES-1).*

Exotherms over -215 cal/dry gram were detected in the first two segments from each core. As a result of these analyses, tank 241-T-111 has been placed on the Organic Watch List[2]. The source of these exotherms remains under investigation; however, under present tank conditions, there is no possibility that a rapid exothermic reaction will occur. Another finding from the characterization analyses was that the present method for determining or measuring total organic carbon was not effective for the organic materials in this waste matrix. Further investigation of the method failure for this waste is underway and other assay methods are being considered.

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[1]Ecology, EPA, and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, 2 vols. as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

[2]Wicks, J. H. 1994, *Tank T-111*, (Internal Memo 94-003 to D. A. Turner, March 3) Westinghouse Hanford Company, Richland, Washington.

Comparisons of the calculated bulk inventories for various analytes of concern show that tank 241-T-111 is within established operating safety requirements for heat-load, ferrocyanide, and plutonium inventory. From assessment of past and present surveillance data, tank 241-T-111 is considered an assumed leaking tank (see Table ES-2). Mitigation presently is taking place to remove the remaining free liquid in the tank in order to forestall any further leakage of tank contents to the environment. The free liquid is being transferred to tank 241-SY-102 as part of the overall single-shell tank stabilization effort[3].

The results of the analyses have been compared to the dangerous waste codes in the "Washington Dangerous Waste Regulations" (WAC 173-303)[4]*. This assessment was conducted by comparing tank analyses against dangerous waste characteristics ("D" waste codes) and against state waste codes. The comparison did not include checking tank analyses against "U," "P," "F," or "K" waste codes because application of these codes is dependent on the source of the waste and not on particular constituent concentrations. The results indicate that the waste in this tank is adequately described in the Dangerous Waste Permit Application for the Single-Shell Tank System; this permit is discussed in the* Tank Characterization Reference Guide.[5]

[3]Jenkins, C. E. and D. B. Engleman, 1994, *Engineering Report: Managing the Assumed Leak from Single-Shell Tank 241-T-111*, WHC-SD-WM-ER-337, Westinghouse Hanford Company, Richland, Washington.

[4]WAC 173-303, "Dangerous Waste Regulations", *Washington Administrative Code*, as amended, Olympia, Washington.

[5]De Lorenzo, D. S., et al. 1994, *Tank Characterization Reference Guide*, WHC-SD-WM-TI-648, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Analysis of the process history of the tank provided valuable information about the likely physical and chemical condition of the waste. Direct comparisons with historical tank reviews underway at Los Alamos National Laboratory are not possible at this time because the Los Alamos National Laboratory effort has not progressed to encompass tank 241-T-111. However, estimates and comparisons using the available process knowledge[6] have been made. Further comparisons with the Los Alamos National Laboratory database will be made when it becomes available in 1995. The available historical information, in combination with the analysis of the tank waste, supports the conclusion that a rapid exothermic reaction in tank 241-T-111 with the present tank conditions is not plausible because of the high moisture content of the waste and lack of any concentrated heat source. Therefore, the contents of tank 241-T-111 present no credible imminent threat to the workers at the Hanford Site, the public, or the environment. Because an exothermic reaction is not credible, the consequences of this accident scenario, as promulgated by the General Accounting Office, are not applicable.[7] However, until the source and mechanism of the exotherm is further clarified, it was considered prudent to list the tank on the Organics Watch List, apply more rigorous access controls, and conduct further intrusive operations in tank 241-T-111 with greater care.

[6]Agnew, S. F., 1994, *Hanford Defined Wastes: Chemical and Radionuclide Compositions*, LA-UR-94-2657, Los Alamos National Laboratory, Los Alamos, New Mexico.

[7]Peach, J. D., 1990, *Consequences of Explosion of Hanford's Single-Shell Tank are Understated*, (Letter B-241479 to C. M. Synar, Chairman of Environment, Energy, and Natural Resources Subcommittee, Committee on Government Operations, House of Representatives), GAO/RCED-91-34, General Accounting Office, Washington, D.C.

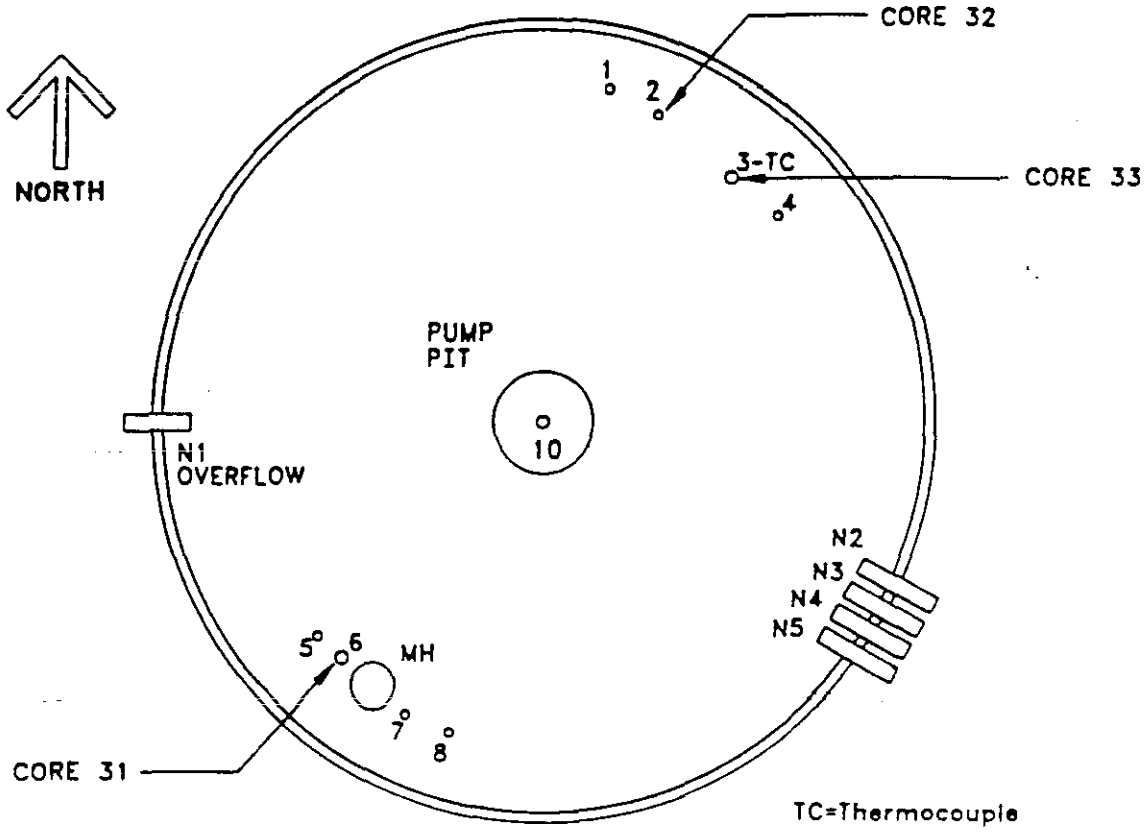
Table ES-1. Single-Shell Tank 241-T-111 Concentrations and Inventories for Critical List Analytes.

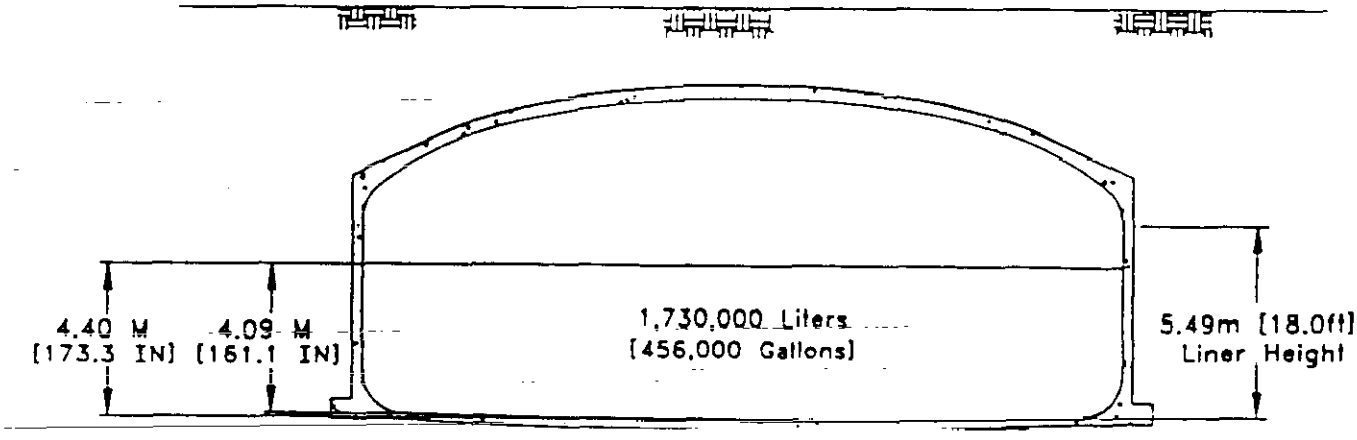
Physical Properties		
Density 1.16-1.28 g/mL	H_2O 76.0%	1,650,000 kg
Temperature 16 °C	Heat Load 81 w (24 BTU/hr)	
pH 11.65	Total Waste Mass	2,171,000 kg
Chemical Constituents	Average Concentration (wt%)	Bulk Inventory (kg)
Calcium (Ca)	0.242	5,260
Chromium (Cr)	0.198	4,290
Iron (Fe)	1.85	40,200
Manganese (Mn)	0.633	13,700
Sodium (Na)	3.70	80,300
Bismuth (Bi)	2.60	56,300
Lanthanum (La)	0.422	9,200
Silicon (Si)	0.567	12,300
Uranium (U)	0.355	7,700
Total Phosphate (PO_4^{-3})	3.23	70,100
Sulfate (SO_4^{-2})	0.355	7,700
Nitrate (NO_3^-)	4.13	89,700
Fluoride (F^-)	0.230	4,990
Total Organic Carbon (TOC)	0.312	6,770
Radionuclides	(μCi/g)	(Ci)
Total Plutonium	0.304	660
Am-241	0.0425	92.4
Sr-90	5.41	11,800
Cs-137	0.166	360

Table ES-2. Tank 241-T-111.

Tank Description	
Type:	Single-Shell
Constructed:	1944
In Service:	1945
Diameter:	75 ft (22.9 m)
Usable Depth:	17 ft (5.2 m)
Operating Capacity:	530,000 gal (2.01E+06 L)
Bottom Shape:	Dished
Hanford Coordinates:	43.347° North 75.737° West
Ventilation:	Passive
Tank Status: as of May 1994	
Contents:	Non-Complexed Waste
Total Waste:	456,000 gal (1.73E+06 L)
Supernate Volume:	0 gal (0 L)
Drainable Interstitial Liquid:	51,000 gal (193,000 L)
Manual Tape Surface Level (under riser):	161.1 in. (408.9 cm)
Liquid Observation Well Level:	158.8 in. (403.4 cm)
Integrity Category:	Assumed Leaker
Watch List Status:	Organic

Figure ES-1.


CORE 32
NORTH
1
2
3-TC
CORE 33
4
PUMP
PIT
10
N1
OVERFLOW
N2
N3
N4
N5
5
6
MH
7
8
CORE 31
TC=Thermocouple


4.40 M
[173.3 IN]
4.09 M
[161.1 IN]
1,730,000 Liters
[456,000 Gallons]
5.49m [18.0ft]
Liner Height

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LIST OF ACRONYMS/ABBREVIATIONS

2C	Second-Cycle Decontamination Waste From The Bismuth Phosphate Process
224	Lanthanum Fluoride Waste
AA	Atomic Absorption
ANOVA	Analysis Of Variance
CI	Confidence Interval
DSC	Differential Scanning Calorimetry
GEA	Gamma Energy Analysis
IC	Ion Chromatography
ICP	Inductively Coupled Plasma - Atomic Emission Spectroscopy
PNL	Pacific Northwest Laboratory
RPD	Relative Percent Difference
SST	Single-Shell Tank
TGA	Thermogravimetric Analysis
TIC	Total Inorganic Carbon
TOC	Total Organic Carbon
Tri-Party Agreement	*Hanford Federal Facility Agreement And Consent Order*

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TANK CHARACTERIZATION REPORT: TANK 241-T-111

1.0 INTRODUCTION

In late October and early November of 1991, single-shell tank (SST) 241-T-111 was sampled and analyses were conducted on the materials obtained to complete *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-10-00 (Ecology et al. 1992) to sample and analyze two cores from each tank. Other objectives that these measurements and inventory estimates support are as follows.

- Obtain estimates of both the concentration and total quantity of key analytes relating to safety issues, such as organics and radionuclides.
- Provide input to risk assessment-based disposal decisions for the waste.
- Implement physical property measurements, such as rheology, bulk density, and particle size. These measurements are necessary for the design and fabrication of retrieval, pretreatment, and vitrification systems.

1.1 PURPOSE

The purpose of the tank characterization report is to describe and characterize the waste in SST 241-T-111, based on information from various sources. This report summarizes the available information regarding the waste in tank 241-T-111, and arranges this information in a format useful to support management and technical decisions concerning this waste tank.

1.2 SCOPE

This report presents a broad background of information that was available before core sampling, which initially guided the development of the sampling and analysis program. This material includes process stream data, historical information about any previous characterization testing, transfer records, and observations from in-tank photographs. The results of tank 241-T-111 core-sample analyses are summarized and presented, along with a statistical interpretation of the data. The information obtained from historical sources will be compared and correlated with the actual waste measurements in this report. As characterization efforts proceed and additional information becomes available, this document will be revised periodically to reflect the new data set.

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2.0 HISTORICAL TANK INFORMATION AND EVALUATION

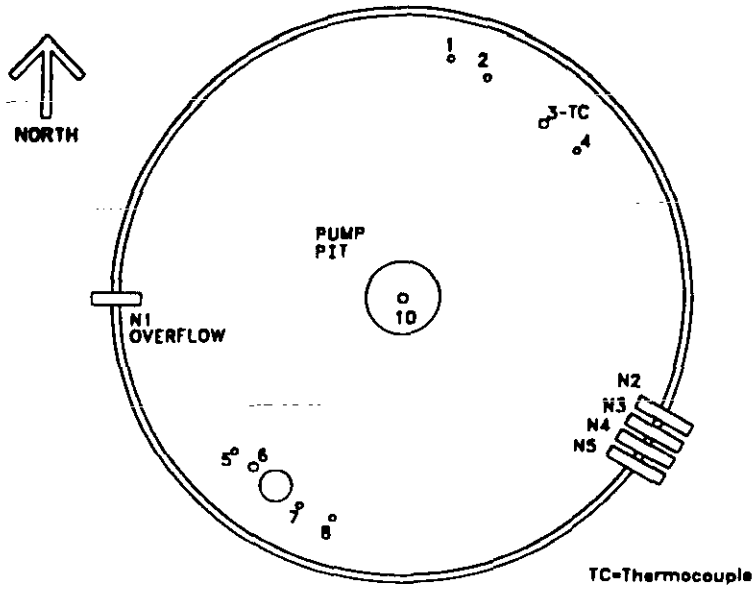
2.1 BACKGROUND

Radioactive wastes from defense operations have accumulated at the Hanford Site in underground waste tanks since the late 1940s. The original tank farms (B, C, T, and U) were built from 1943 to 1944. Tank 241-T-111 was placed into service in 1945. Groups of waste tanks that were physically located together and built at the same time are called tank farms. Each original tank has a diameter of 22.9 m (75 ft), an operating depth of 5.2 m (17 ft), and a nominal capacity of 2 million liters (530,000 gal). The basic design of a typical SST is shown in Figure 2-1. The tanks were constructed of reinforced concrete with a mild steel liner covering their bottoms and sides. The carbon steel liners were designed to receive and contain neutralized, mildly alkaline wastes. The tops of the tanks are concrete domes. Tanks such as 241-T-111 were all covered by at least 1.8 m (6 ft) of soil for shielding purposes (Anderson 1990). The tanks in the tank farms were connected in groups of three or four and overflowed from one to another in a configuration known as a cascade. Tank 241-T-111 is the middle tank in a cascade that includes 241-T-110 and 241-T-112. Cascades served several functions in Hanford-Site waste management operations. By cascading tanks, fewer connections needed to be made during waste disposal. Consequently, all three tanks were usable without having to connect the active waste transfer line directly to each individual tank. This handling method reduced the likelihood for personnel exposure to the waste and diminished the chances for a loss of tank integrity because of overfilling. Another benefit of the cascades was clarification of the wastes. When used in this manner, most of the solids in the waste slurries routed to the tanks settled in the first tank (241-T-110), and the clarified liquids cascaded on to the other tanks in the series (241-T-111 and 241-T-112). Supernate from the final tank in a cascade series was sometimes routed to a disposal trench. Since most radionuclides are insoluble in aqueous alkaline media, clarification reduced the potential amount of radiological contamination to the environment. However, historical sources report that cascade lines routinely clogged (Anderson 1990). When clogging occurred, very little could be done to resolve the problem, other than re-routing the effluent stream directly to the disposal tank. Cascading was a common practice in the early process history of the tanks, but became less frequent as time passed, virtually ceasing by the late 1950s.

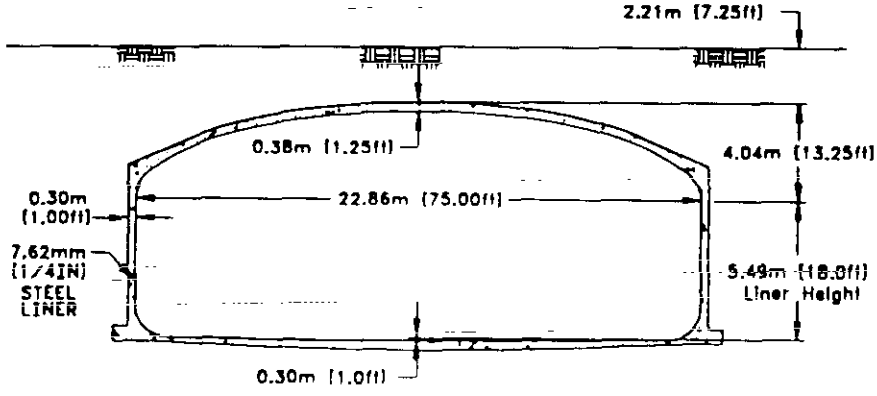
2.2 TANK 241-T-111 HISTORY

The first type of waste that tank 241-T-111 received and stored was second-cycle decontamination waste from the bismuth phosphate process (2C) (1945 to 1952). The tank was filled by a cascade of 2C waste in the fourth quarter of 1945. The supernatant in the tank was disposed to a crib in the third and fourth quarters of 1947. The tank was then re-filled with 2C waste in the second quarter of 1948. After the cascade was filled again in late 1948, tank 241-T-111 remained in active service. From 1953 to 1955, tank 241-T-111 was

Figure 2-1. Typical Single-Shell Tank Diagram.



TANK RISER LOCATION



Note: Tank 241-T-111 has a dished bottom.

used to cascade 2C and lanthanum fluoride waste (224) from the LaF_3 finishing process in T Plant to a crib. In addition, Anderson (1990) reports that some 5-6 cell drainage out of B Plant was routed to the tank along with 224 waste in 1952.

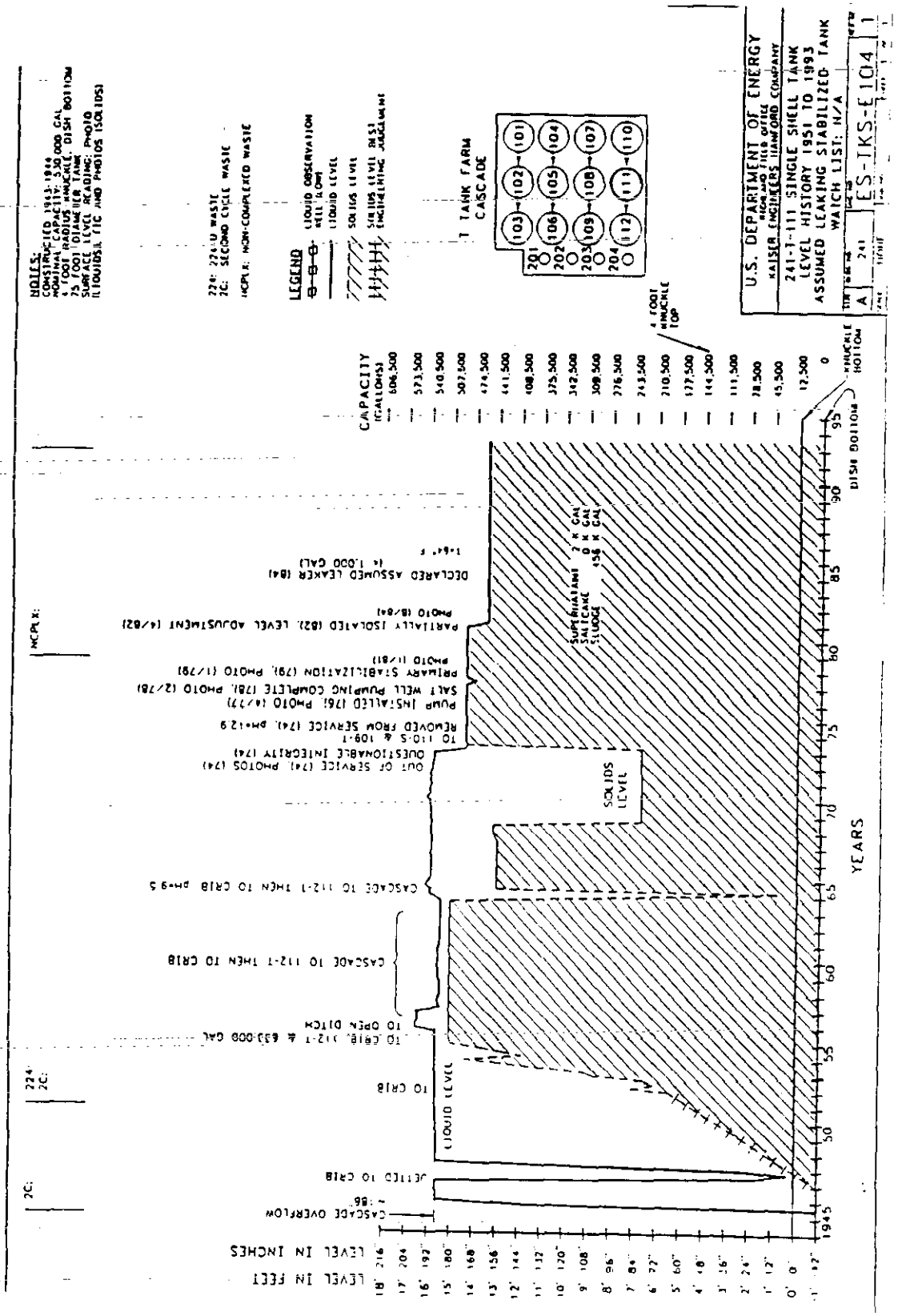
After the end of the T-Plant cascade in 1955, the reported total waste volume remained relatively unchanged [between 1.98 and 2.12 million L (524,000 and 560,000 gal)] for the remainder of the tank's active service life. There was a residual heel of at least 1.85 million L (488,000 gal) left from previous waste management operations. Tank 241-T-111 remained in 2C service through the third quarter of 1956 (T Plant ran $BiPO_4$ until August 1956). Anderson (1990) notes that in 1952 the tank was also receiving 224 waste from the plutonium purification/concentration processes performed in the 224-T building.

T Plant initially was built as a bismuth phosphate processing plant, however that purpose was changed when it became an equipment decontamination facility. The tank would have also received miscellaneous decontamination chemicals from T-Plant decontamination operations performed in the 1960s. The records are not clear whether tank 241-T-111 always received waste as overflow from tank 241-T-110, or if waste was later routed directly to it. There is anecdotal evidence that the cascade overflow line plugged early in the service life of tank 241-T-110, and that a direct discharge line from T Plant was used to dispose of wastes to tank 241-T-111, however no reference confirming this fact can be found. Between 1964 and 1974, the reported solids volume fluctuated widely between 1.93 and 0.88 million L (510,000 and 233,000 gal). A highly anomalous reading of 150,000 L (40,000 gal) is not considered credible and is believed to be the result of a transcription error. In that time period, the total volume reported rose slightly, then decreased from 2.06 million L to 1.85 million L (541,000 to 488,000 gal) (Anderson 1990). In the second quarter of 1974, there were two small transfers out of Tank 241-T-111: one of 106,000 L (28,000 gal) to tank 241-S-110 and one of 53,000 L (14,000 gal) to tank 241-T-109.

In the third quarter of the same year, dry wells 50-11-05 and 50-11-08 were drilled and in the fourth quarter of 1974, tank 241-T-111 was removed from active service. In the first and second quarters of 1976, two minor transfers of 30,300 L and 19,000 L (8,000 and 5,000 gal), respectively, were made out of tank 241-T-111. Saltwell pumping commenced in the third quarter of 1976 as part of the tank stabilization effort, and no further waste receipts were made. In 1979, the integrity of the tank was questioned and dry well 50-11-11 was drilled in the third quarter. As a result of an observed level drop, tank 241-T-111 was declared an assumed leaker in 1984 (Hanlon 1994). Figure 2-2 illustrates the fill and transfer history of 241-T-111.

The wide fluctuation in the early reported solids level makes it difficult to derive any firm conclusions regarding the stratification in the tank on a strictly historical basis. Overall sludge volume in the tank may have decreased somewhat between 1956 and 1974 with further settling and compaction from the weight of overlying solids. The amount of sludge added since the end of the T-Plant cascade activity probably is negligible, because the transfer history of the tank was so limited. Floating suction pumps do not transfer solids

Figure 2-2. Fill and Transfer History of 241-T-111.



readily, and the movement of more than 950,000 L (250,000 gal) of solids in a quarter seems unlikely. However, the reported solids measurement in the fourth quarter of 1956 [1.93 million L (510,000 gal)] and the reported solids measurement at the end of the tank's active service life in 1980 [1.85 million L (488,000 gal)] appears to be reasonable, a 4.5 percent difference, given the time and compaction processes ongoing in the tank, and the inherent uncertainties associated with early solids measurements in the tank farms.

2.3 PROCESS KNOWLEDGE

Process knowledge obtained from historical records can be used to predict the major constituents and some general physical properties of the waste matrix in the tanks. Tank 241-T-111 is expected to contain relatively soft sludge, which can be push-mode sampled. During its operating history, tank 241-T-111 was never subject to any of the various waste volume reduction or in-tank solidification processes. Consequently, there was no formation of hard salt cake on top of the sludge, as there was in the BY or TX Tank Farms (Anderson 1990). This expectation was supported by inspection of in-tank photographs that indicated a moist and pliant waste surface (see Figures 2-3 and 2-4). The effluents that were added to the tank during waste management operations were slurries consisting primarily of water (Schneider 1951). There was no mixing equipment in tank 241-T-111 to blend the layers of settled solids together and there were distinct differences in the composition of wastes directed to it over its operating life. Agnew (1994) predicts that 2C and 224 wastes are not identical in makeup, and analytically observable variations in composition are expected. Because of the lack of agitation or mixing in the tank, observable evidence of layering is expected in some of the segment-level analytical results.

Previous analytical data on tank 241-T-111 is scant. The results of some liquid samples taken in 1974 are provided in Appendix C. Because the tank has been pumped several times since those samples were taken, they are not considered representative of the present waste matrix. The lower solids in tank 241-B-110 should be similar to the lower solids in tank 241-T-111 (Borsheim 1994). Both tanks were filled at least twice with 2C. Tank 241-B-110 was the first tank in the B-Plant 2C cascade while tank 241-T-111 was the second tank in the T-Plant 2C cascade. Further studies and comparisons of tank compositions will be forthcoming, pending additional analytical information on the various waste types and matrices that exist in the tank farms. The solids from the neutralized solution would have settled out in the tanks while the supernatant was disposed to cribs. The upper solids of tank 241-T-111 should have some similarity to the B and T 200-series tanks, because they all received 224 waste.

The estimated composition of neutralized 2C and 224 waste streams (i.e. unsettled) are given in Table 2-1 as determined from Schneider (1951). The Schneider (1951) process stream compositions are for the unsettled wastes being transferred from the separations plants. The

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Figure 2-3. 241-T-111 Surveillance Photo - Collage.

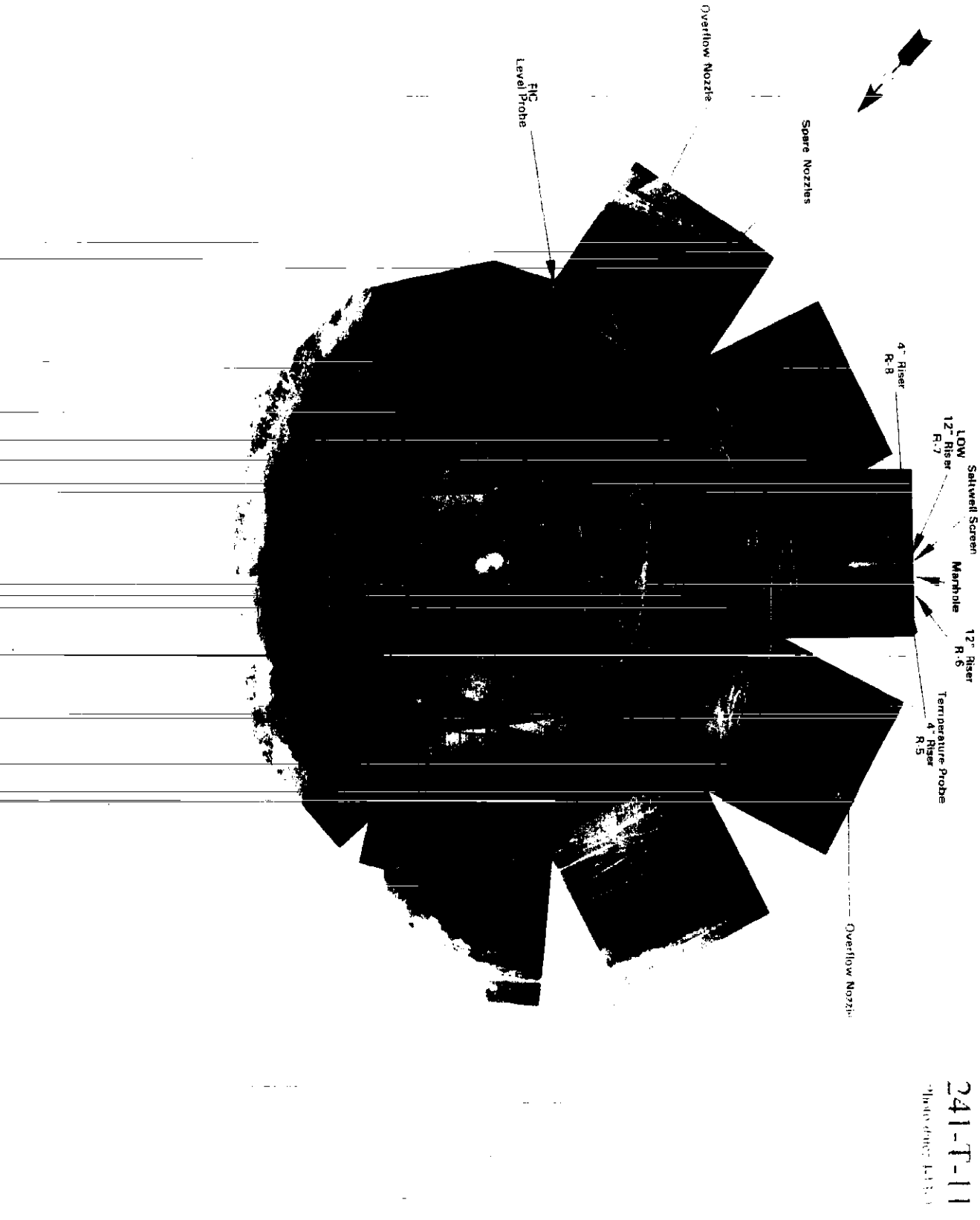

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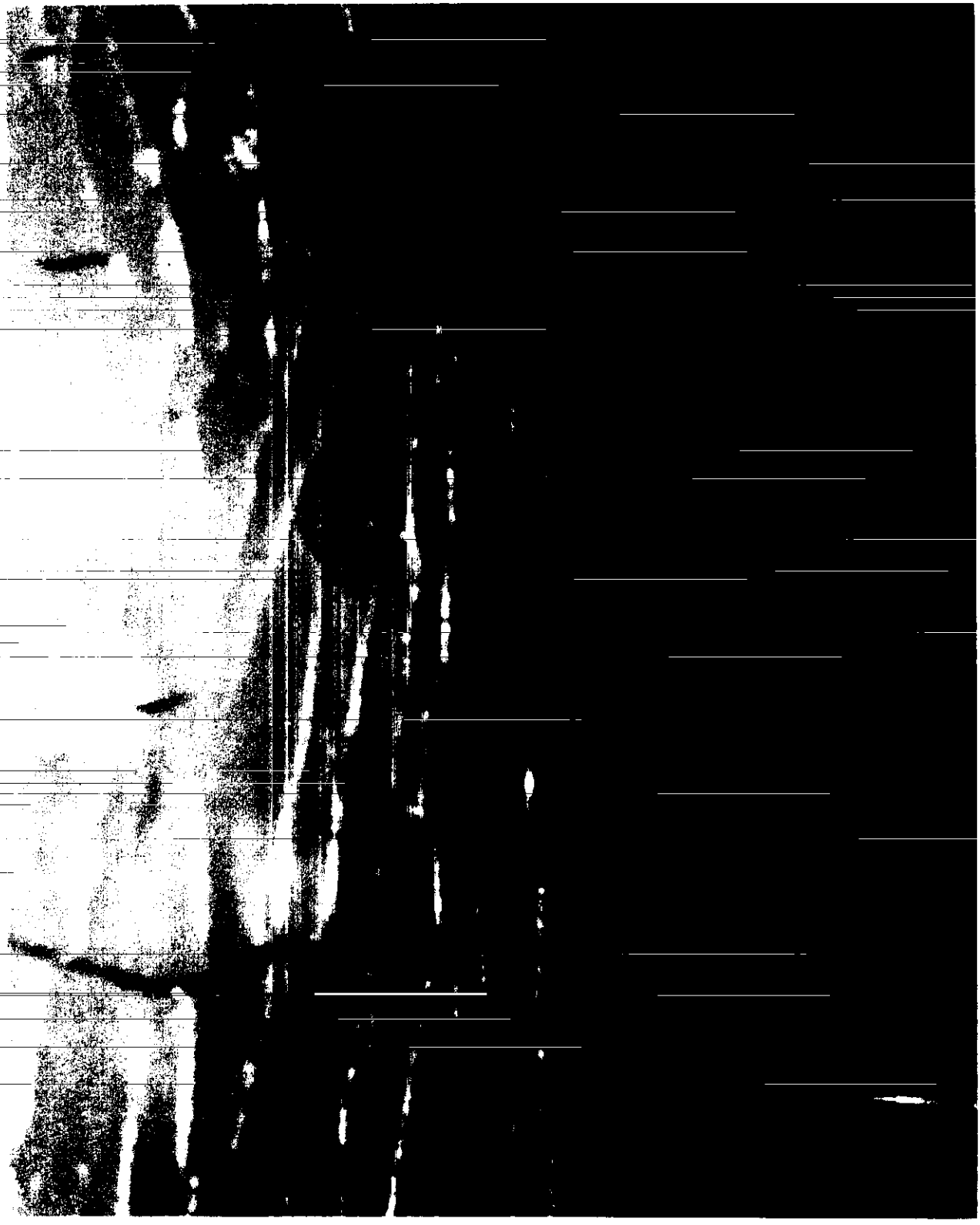
Figure 2-4. 241-T-111 Surveillance Photo - Close up.



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estimates using Agnew (1994) provide insight to the analyte concentrations of the settled sludge. How the waste settled, the solids content of the settled waste, and how it affected the waste inventory of the tank will be discussed further in Section 6.

Table 2-1. Typical Waste Stream Compositions and Expected Sludge Compositions for Selected Analytes (Wet Basis).

Analyte	Unsettled 2C $BiPO_4$ waste (Schneider 1951)		Settled 2C $BiPO_4$ waste, (Agnew 1994) average 1944-1951 and 1951-1956 compositions		Unsettled $BiPO_4$-LaF_3 224 process waste (Schneider 1951)		Settled $BiPO_4$-LaF_3 224 process waste (Agnew 1994)	
Cation	Wt %	(μg/g)	Wt %	(μg/g)	Wt %	(μg/g)	Wt %	(μg/g)
Bi	0.12	1,200	2.55	25,500	0.11	1,100	2.07	20,690
Cr	0.006	60	0.0033	33	0.016	160	0.0035	35
Na*	3.5	35,000	6.46	64,600	3.39	33,900	8.50	85,000
NH_4^+**	0.16	1,600	-	-	0.011	110	-	-
Fe	0.17	1,700	1.79	17,900	-	-	0	0
Mn	-	-	0	0	0.031	310	0.019	190
K	-	-	0	0	0.79	7,900	0.779	7,790
La	-	-	0	0	0.05	500	2.67	26,700
Anions								
PO_4^{3-}	2.2	22,000	5.63	56,300	0.28	2,800	1.25	12,500
SO_4^{2-}	0.34	3,400	0.276	2,760	0.032	320	0	0
NO_3^-	5.8	58,000	4.28	42,800	3.91	39,100	6.16	61,600
F^-	-	-	0.494	4,940	0.52	5,200	4.66	46,600
SiF_6^{2-}	0.35	3,500	-	-	-	-	-	-
$C_2O_4^{2-}$	-	-	-	0	0.12	1,200	1.52	15,200
H_2O	87.3	873,000	76.0	760,000	90.75	907,500	69.0	689,600

*Analytes listed in italics are mostly soluble.

**NH_4^+ probably has dissipated over time and is believed to be no longer present.

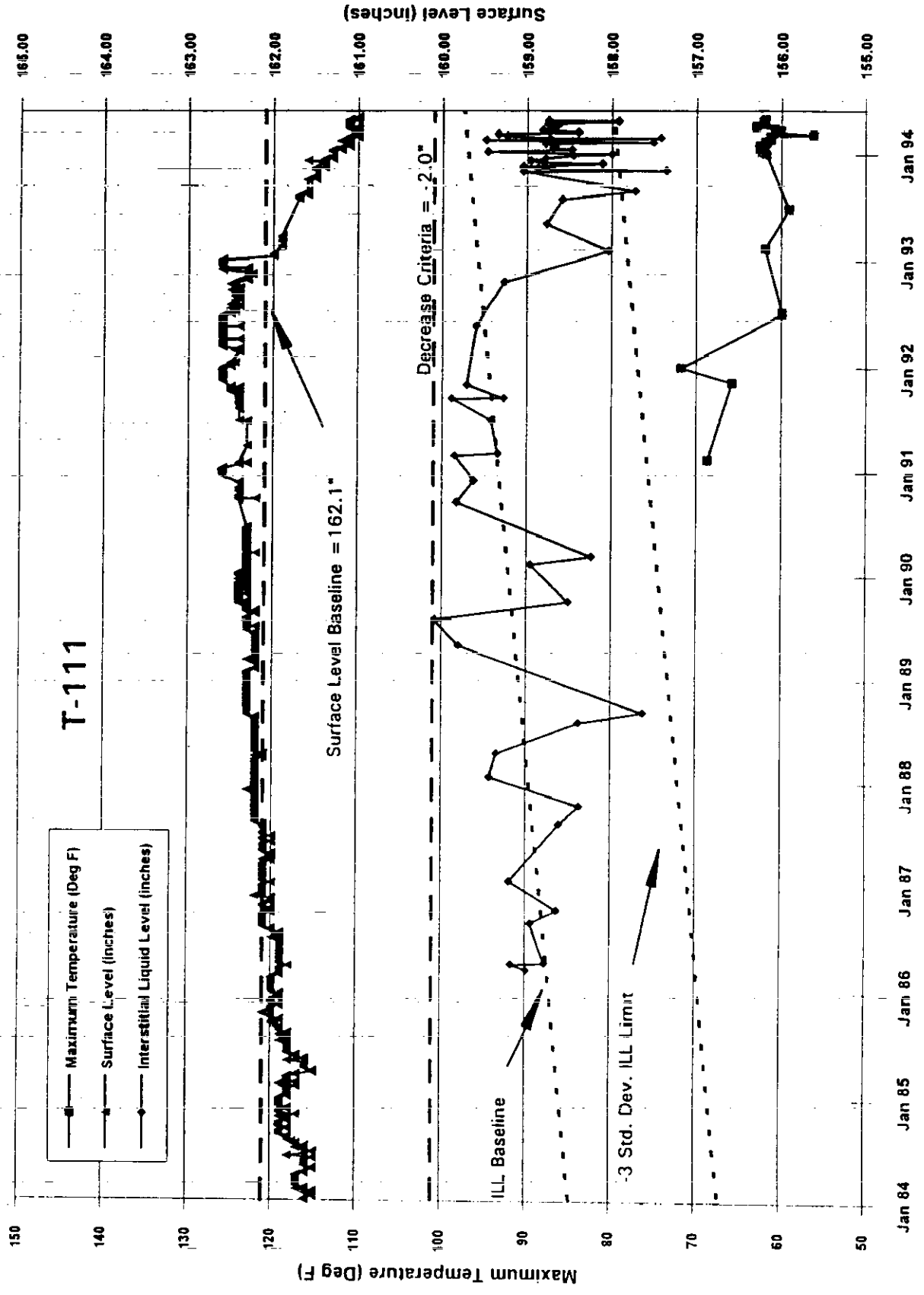
2.4 SURVEILLANCE DATA

The most recent waste inventory measurement for tank 241-T-111 reports approximately 1.73 million L (456,000 gal) of solid waste with an estimated 193,000 L (51,000 gal) of drainable liquids (Hanlon 1994). The most recent surveillance data shows a discernable downward trend over the past 18 months, nearly a 3.8 cm drop in surface level, after a very long, gradual, but minor upward trend over the last ten years (see Figure 2-5). This recent behavior possibly indicates further settling, or leaking has taken place. These figures translate to a waste depth of 408.9 cm (161.1 in.) underneath the riser and 440.2 cm (173.3 in.) at the tank centerline. The tank has not been fully interim stabilized yet, and is an assumed leaker. The recent waste temperature in tank 241-T-111, taken from a thermocouple tree is approximately 16 °C (60.5 °F) (Rios 1994), and the estimated heat load in the tank is less than 2.93 kW (10,000 Btu/hr).

2.5 TANK STATUS

Tank 241-T-111 was a non-watch-list SST, with no historical indication of any potential safety issue. However, during the review of the energetics data that was done in support of characterization, exotherms in excess of -125 cal/dry gram of waste were noticed in the top 3 segments of core 31 and the top 2 segments of core 33. Additional follow-up work has been done confirming the initial observation and as a result, 241-T-111 has been added to the Organic Tank Watch List (Wicks 1994). The exotherms were not predicted from the process history of the tank and the known characteristics of the 2C and 224 waste streams disposed there.

Figure 2-5. 241-T-111 Surveillance Data.



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3.0 TANK SAMPLING OVERVIEW

3.1 DESCRIPTION OF SAMPLING EVENT

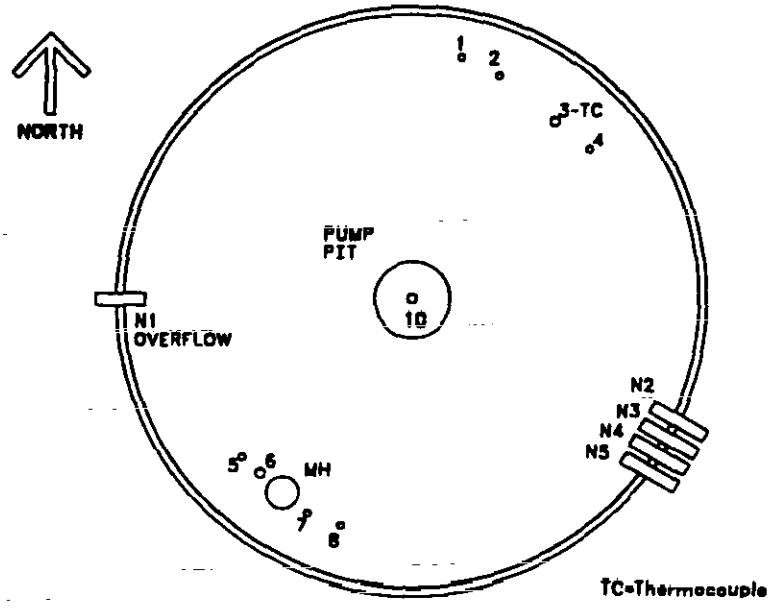
Tank 241-T-111 was push-mode core sampled through three risers during a period from October 22, 1991 to November 7, 1991. The core samples were obtained using a specially designed core sampling truck. Access to the interior of the tank is provided by various tank risers. Risers are pipes of various diameters leading into the tank dome from the ground. The riser configuration for tank 241-T-111 is given in Figure 3-1. A review of the tank farm operating records and a field inspection of the tank risers determine which risers can be used in the sampling operation. During sampling, a riser is opened and the truck is positioned over the riser. The sampler is lowered into the tank through the drill string and pushed into the waste. Further information regarding the core sampling operation can be found in *Tank Farm Operating Procedure* (Ross 1993). Nine segments were expected from each core sample. Each segment is approximately 48 cm (19 in) long. Core 31 was obtained from riser 6 on October 22, 1991. Core 32 was obtained from riser 2 from October 24, 1991 to October 25, 1991. Core 33 was obtained from riser 3 on November 5, 1991 to November 7, 1991.

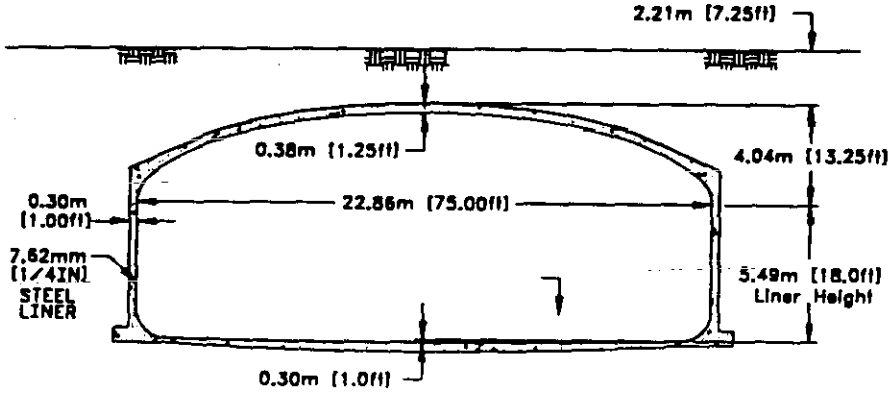
The sampler is constructed of stainless steel and is 48 cm (19 in) long, with a 2.2-cm (7/8-in) inside diameter, and has a volume of 187 mL (0.05 gal). A hydrostatic fluid of normal paraffin hydrocarbons, similar to kerosene, was used in establishing a head balance while taking these cores. Objections involving sample degradation and contamination have been raised regarding the use of this fluid, and the practice has since been discontinued. However, for cores 31 and 33, nearly full recovery was achieved in every case. There were little or no drainable liquids observed in the sample liners or in the samplers upon extrusion of the samples, and although hydraulic permeability measurements were not taken as part of the characterization effort, the waste did not appear porous. Thus, sample contamination from the hydrostatic fluid is not deemed to be a significant issue with the analysis of the sample or the interpretation of the results.

The casks were transported to the 222-S Laboratory for characterization analysis. This facility is operated by Westinghouse Hanford Company in the 200 West Area of the Hanford Site. Further physical and radiochemical characterization was performed at the 325 Laboratory. Specific analyses aimed at identifying and resolving the unusual energetics observed (Bean 1994) are also being done at 325 Laboratory. That facility is operated by Battelle Pacific Northwest Laboratory (PNL), and is located in the 300 Area of the Hanford Site.

Before the most recent stabilization effort, a series of liquid grab samples were taken and analyzed to ensure waste compatibility with the tank receiving the 241-T-111 liquid waste. These grab samples were acquired using a sampling method known as "bottle-on-a-string," in which a weighted bottle with a shuttered mouth is lowered into the liquid waste. The bottle's

Figure 3-1. Tank 241-T-111 Riser Configuration.





mouth is opened, it fills with liquid, the mouth is closed, and the sample is retrieved and transported to the 222-S Laboratory. Winters et al. (1990a and 1990b) has a more detailed description of this sample method.

3.2 CHAIN OF CUSTODY

A chain-of-custody record was kept during the sampling event for each segment that was sampled. The chain-of-custody form is a one-page record that is used to ensure that (1) the sample is safely and properly transported from the field to the laboratory, and (2) the correct personnel are involved in the sampling operation and transportation of the sample to the laboratory.

One of the additional functions of the chain-of-custody record is to provide radiation survey data. This is a record of the radiation dose that is emitted from the shipping cask. The dose rates in mrem/hour are measured from the top, sides, and bottom of the cask. These values are recorded on the chain-of-custody record and represent the radiation being emitted directly from the sample. The last item recorded under the radiation survey data is the smearable contamination. Smearable contamination represents the radiation from waste material that is not sealed within the shipping cask; values greater than 100 mrem/hour are considered unsafe. Measurements are made both in the field and in the laboratory. No smearable contamination was found with these samples.

The chain-of-custody has several other important functions: (1) to provide a modest description of the cask, sampler, and the expected contents of the sampler (shipment, sample, and cask serial numbers for the specific sampling event); (2) to provide summary information about the analytical suite that the sample will undergo or reference the salient documentation; (3) to provide traceability for the sample during transport; and (4) to ensure sample integrity on arrival at the laboratory. This information is provided to ensure that each sample can be uniquely identified. A summary of the most pertinent data contained in the chain-of-custody forms for the tank 241-T-111 samples is presented in Tables 3-1 and 3-2.

Copies of the chain-of-custody forms are available in the full data package and through Hanford-Site Central Files. From inspection of the chain-of-custody records, there appear to be irregularities in the sampling and transport of tank 241-T-111 samples. Valve failures were observed in individual segments in all three core samples, and core 32 was considered to be completely compromised and non-representative. Each segment was almost entirely aqueous, containing at most a small amount of suspended solids. Liquid was also found in some of the liners surrounding the samplers from core 32, and was assumed to be leakage from the sampler. These irregularities merit a sampling concern, sample integrity concern, and potential safety concern (i.e., sample containment was compromised). However, the double-containment strategy employed in the handling of the samples was successful in preventing any excessive radiological exposure to personnel and no material escaped confinement. Further investigation and refinement of the sampling process, procedures, and sampler design is in progress.

Table 3-1. Core 31--Chain of Custody Summary.

Sample	Core 31
Place Taken	241-T-111 Riser 6
Date Taken	10/22/91
Date Released	10/23/91
Time Released	9:35 P.M.
Sender	D. C. Hartley
Receiver	V. Johansen
Place Received	222-S Laboratory
Time Received	10:00 P.M.

Sample Number	Smearable Contamination	Dose Rate Through the Drill String
91-090 (Segment 1)	< DL alpha < DL beta-gamma	4.5 mR/hr
91-091 (Segment 2)	< DL alpha < DL beta-gamma	2.4 mR/hr
91-092 (Segment 3)	< DL alpha < DL beta-gamma	2.5 mR/hr
91-093 (Segment 4)	< DL alpha < DL beta-gamma	2.0 mR/hr
91-094 (Segment 5)	< DL alpha < DL beta-gamma	1.5 mR/hr
91-095 (Segment 6)	< DL alpha < DL beta-gamma	1.5 mR/hr
91-096 (Segment 7)	< DL alpha < DL beta-gamma	0.5 mR/hr
91-097 (Segment 8)	< DL alpha < DL beta-gamma	1.5 mR/hr
91-098 (Segment 9)	< DL alpha < DL beta-gamma	0.3 mR/hr

< DL = below detection limit

Table 3-2. Core 33--Chain of Custody Summary

Sample	Core 33
Place Taken	241-T-111 Riser 3
Dates Taken	11/5/91 to 11/6/91
Dates Released	11/6/91 to 11/7/91
Sender	D. C. Hartley
Receiver	V. Johansen
Place Received	222-S Laboratory
Times Received	See Below

Sample Number/ Date Sampled	Date Released/ Time Released/ Time Received	Smearable Contamination	Dose Rate Through the Drill String
91-108 (Segment 1) 11/5/91	11/6/91 10:10 10:55	< DL alpha < DL beta-gamma	3 mR/hr
91-109 (Segment 2) 11/5/91	11/6/91 10:10 10:55	< DL alpha < DL beta-gamma	2.5 mR/hr
91-110 (Segment 3) 11/5/91	11/6/91 10:10 10:55	< DL alpha < DL beta-gamma	10 mR/hr
91-111 (Segment 4) 11/5/91	11/6/91 14:10 14:30	< DL alpha < DL beta-gamma	5 mR/hr
91-112 (Segment 5) 11/6/91	11/6/91 14:10 14:30	< DL alpha < DL beta-gamma	< 0.5 mR/hr
91-113 (Segment 6) 11/6/91	11/6/91 14:10 14:30	< DL alpha < DL beta-gamma	2 mR/hr
91-114 (Segment 7) 11/6/91	11/7/91 10:10 10:35	< DL alpha < DL beta-gamma	1.5 mR/hr
91-115 (Segment 8) 11/6/91	11/7/91 10:10 10:35	< DL alpha < DL beta-gamma	1 mR/hr
91-116 (Segment 9) 11/6/91	11/7/91 10:10 10:35	< DL alpha < DL beta-gamma	1 mR/hr

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4.0 SAMPLE HANDLING AND ANALYTICAL SCHEME

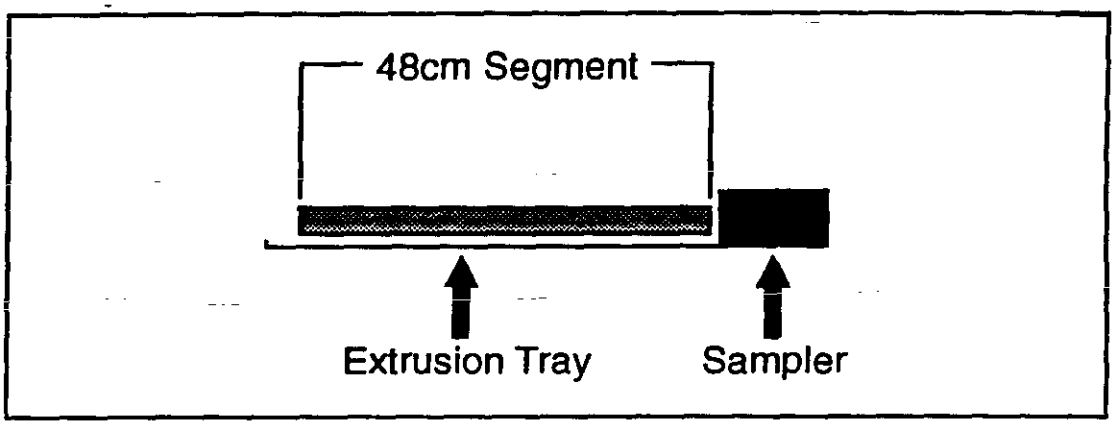
The primary objective for these waste analyses was to meet requirements of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1992, Ecology et al. 1994). Two composites from each core were built and analyzed in accordance with the complete baseline case core composite scenario detailed in WHC-EP-0210 (Winters et al. 1990a, Winters et al. 1990b) and as amended by Hill et al. (1991). However, there are other concerns and interests for this data. First, this information will help to evaluate whether constituent concentrations are within safe operating limits by determining whether they are flammable or explosive. Second, analyte concentrations of interest to the various Hanford-Site technical programs can be determined.

Because tank 241-T-111 initially was identified as a non-watch-list tank, extensive analytical measurements were not specified to resolve any previously identified safety concerns associated with this tank. The analysis horizon for characterization was determined to be on the core composite level with selected analyses being performed on a segment-level basis. However, after the discovery of substantial exotherms in the top 100 cm (40 in) of the waste, additional testing on a segment level basis was done on those samples exhibiting reactive behavior. This additional testing, with an emphasis on providing resolution to the safety issues raised by the presence of the exotherms in the waste is still underway at the time of the writing of this report. This report will be updated to reflect the new data or root causes of the energetics when that information becomes available.

4.1 SAMPLE BREAKDOWN PROCEDURE

In order to obtain the sample, the sampler is shipped in a vertical position and removed from the shipping cask directly into the hot cell. At this time, the sampler must be placed in the horizontal position. The sample is then loaded into the mechanical extruder and removed by pushing it out from the back of the sampler with a piston. In this case, the sampler is pressed against a fixed piston, forcing the sample into the extrusion tray. If a full sample is captured, the material nearest the valve will be from a deeper part of the tank. The material near the piston is closer to the surface. The sample and any liquids are collected on a metal tray. Next, the mass of the segment and the approximate length are recorded. From this information, the gross bulk densities of the segments can be estimated until further physical properties work is performed. The sample volume is determined by measuring the length of the extruded sample using a linear unit volume of 9.85 mL/in. Figure 4-1 illustrates how the SST segment sample was extruded. Color photographs documenting the extrusions of each of the segments from tank 241-T-111 were taken and are on file at the 222-S Laboratory.

Figure 4-1. Typical Single-Shell Tank Segment Extrusion.



29409011.1

Several different styles of nomenclature presently are used for distinguishing core samples, sample segments, and subsegments in the existing literature. Two major conventions are used in the documentation relating to core sampling in general. The first is designating the segment with the last two digits of the calendar year (92-) and then numbering the segments sequentially (-001, -002, etc.). This system resets itself every calendar year. The second system distinguishes the tank, core, segment (and subsegment, if necessary), with segment 1 being the at the top of the core sample and having the number increase as a function of depth in the tank so that segment 9 is at the bottom of the tank in 241-T-111. An example of this naming protocol for the second segment of the first core is 241-T-111-Core 31-Segment 2. Where no tank identification is given in this report, it is understood to mean tank 241-T-111.

4.2 TANK 241-T-111 CORE SAMPLE DESCRIPTION

The location of the risers, the dished bottom of the tank, and safety margins in the sampling protocol preclude obtaining samples from the entire waste depth in the tank. In addition, the sampling protocol establishes that segments will be calculated from the bottom up. Thus, depending on the waste depth, maximum recovery for the top segment from tank 241-T-111 is not necessarily going to be a full 48-cm (19-in) segment. However, for cores 31 and 33, sample recovery was excellent; overall recoveries were in excess of 80 percent. Segment recoveries were based on the maximum recoverable volume for the segment regardless of solid/liquid ratio. The core recoveries reported in the data package are determined based on a visual inspection of the sample length and apparent volume at the time the samples are extruded. Further study of the color photographs taken after extrusion can aid in clarifying a rough sample volume. Tables 4-1 and 4-2 present the initial measurements and observations regarding the core samples on extrusion, and an estimated range of the core recovery on a volume basis for cores 31 and 33.

Although samples for core 32 were taken from riser 2, the materials obtained at all levels appeared to be particulate suspended in an aqueous solution, with slight traces of normal paraffin-hydrocarbon contamination observed in a few samples. These samples did not correspond to the observed conditions in the tank and were considered non-representative. The results of the core-32 sampling exercise were attributed to sampler failure, and because no acceptable samples were acquired, no assays were performed. Therefore, no results for core 32 will be reported. Valve failures were reported routinely for all three core samples at deeper positions in the tank. The full data package (McKinney et al. 1993) containing all of the assay results is available from the Hanford-Site Central Files.

General characteristics of tank 241-T-111 waste materials are as follows.

- Very little drainable liquid was associated with these samples either in the liner or in the extruder.

- Core samples generally were dark brown or black in color. The brown solids were streaked through with grey/white material.

Table 4-1. Tank 241-T-111 Core 31 Sample Description Summary.

Core number (Riser 6)	Segment	Core recovery (Vol. basis)	Total mass (g)	Comments
31	1	27%	64.0	Sampler was nearly empty; contained approximately 50 mL of black/brown low viscosity solids. Apparently homogeneous.
31	2	80-100%	182.8	Sampler was almost completely filled with solids. Again, the material is dark brown or black with a fluid or gel-like consistency, and appears to be homogeneous. A small amount of liner liquid was observed. The liquid was observed to be two phase (NPH and aqueous phases).
31	3	95-100%	162.2	Sampler was almost completely filled with solids. The waste is dark brown with a thick, viscous consistency, and appears to be completely homogeneous.
31	4	80-100%	153.5	Sampler was almost completely filled with solids. The waste is dark brown with a thick, viscous consistency, and appears to be completely homogeneous. The top eighth contained waste material that appeared to be more fluid than the rest of the sample. No sampler liquid or liner liquid was observed.
31	5	100%	190.9	Similar to previous observations; no sampler or liner liquid.
31	6	0%	NA	Sampler empty.
31	7	90-100%	186.4	Sampler was almost completely filled with solids. The waste is dark brown with a thick, viscous consistency, and appears to be completely homogeneous.
31	8	100%	186.4	Similar to previous observations; no sampler or liner liquid.
31	9	100%	203.1	Sample was not homogeneous. Sample began as before (dark brown and viscous), but gradually became lighter as a function of depth. Sample was divided into two portions, a light end (133.4 g) and a dark end (69.7 g). Consistency of the sample remained the same throughout.

Table 4-2. Tank 241-T-111 Core 33 Sample Description Summary.

Core number (Riser 3)	Segment	Core recovery (Vol. basis)	Total mass (g)	Comments
33	1	100%	159.16	Sampler was full of black/brown low viscosity solids. Apparently homogeneous, with no drainable liquid.
33	2	100%	207.59	Sampler was completely filled with solids. Again, the material is dark brown or black with a viscous consistency, and appears to be homogeneous.
33	3	87-100%	167.9	Sampler was nearly filled with solids. The waste is dark brown with a thick, viscous consistency, and appears to be completely homogeneous.
33	4	75-85%	182.05	Sampler was 75-85% filled with solids. The waste is dark brown with a thick, viscous consistency, and appears to be completely homogeneous. The valve was observed to be open prior to extrusion. No sampler liquid or liner liquid was observed.
33	5	88%	174.3	Similar to previous observation, the valve was observed open, the sampler had approximately 88% solids, and no drainable or liner liquid was seen.
33	6	100%	217.37	Sampler was almost completely filled with solids. The waste is dark brown with a thick, viscous consistency, and appears to be completely homogeneous.
33	7	100%	196.91	Sampler was almost completely filled with solids. The waste is dark brown with a thick, viscous consistency, and appears to be completely homogeneous.
33	8	100%	199.8	Similar to previous observations. No sampler or liner liquid.
33	9	100%	191.01	Sample was not homogeneous. Sample began as before (dark brown and viscous) but gradually became lighter in color as a function of depth, similar to core 31. Aliquots from the light and dark portions were taken for VOA and energetics analyses. Consistency of the sample remained the same throughout.

- The samples had a viscous or gel-like consistency. They were thick, relatively smooth sludges (swamp mud was the descriptive term used by the hot-cell observer). The core materials all appeared to be saturated with liquid, which did not drain.

4.3 HOLD TIME CONSIDERATIONS

All analytes have a predetermined maximum allowable holding time set by the Environmental Protection Agency (EPA 1986), during which the analysis should be completed. Completion of analysis during the maximum allowable holding time enhances the regulatory defensibility of the data. The length of the holding time varies for each analyte. For example, analyses performed on volatile and semivolatile organic compounds, many of which decompose or dissipate quickly, have shorter holding times. On the other hand, persistent analytes such as metals (except mercury), do not readily decompose or dissipate, and therefore have much longer acceptable holding times. Nearly all of the analyses of cores 31 and 33 exceeded their respective maximum allowable holding times. The only analyses that came close to meeting holding-time criteria were radiochemistry and metal analyses. Both of these analyses were completed about six months after sampling, and six months is the maximum hold time for these analyses. Although exceeding the maximum allowable holding times weakens the defensibility of the analytical results for some uses, it is anticipated that the overall effect on the analytical results for tank 241-T-111 waste relative to waste management and disposal information needs is minimal. Further discussion of holding times can be found in Winters et al. (1990a).

4.4 SAMPLE PREPARATION

Sample preparation procedures are conducted in order to optimize the recovery of each analyte of interest from the tank waste. Water digestion, acid digestion, and potassium hydroxide fusion commonly are used to extract metals and several radioisotopes from solid samples, and in some cases digestions are performed on liquid samples to improve analytical resolution. Many separations are specific to a particular analysis and are described within the corresponding analytical methods referenced in Section 4.5. In order to verify analyte recoveries resulting from separation techniques, laboratory control samples, carriers, spikes, tracers, and surrogates are analyzed concurrently with the characterization samples.

In some cases no sample preparation is necessary or desired. Direct analyses are assays performed on the sample matrix with little or no sample preparation. Several direct analyses were performed relating to the physical or energetic properties of the waste: density, thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and gravimetric weight percent water.

Water leach (or water digestion) analyses are assays performed after the sample matrix has been digested in distilled/deionized water. The water is then analyzed for soluble analytes. The soluble anions are determined by ion chromatography (IC). The primary anions analyzed in this manner are fluoride, chloride, nitrate, nitrite, phosphate, and sulfate. In addition, free cyanide and pH were also analyzed from water digestion samples. Note that IC assays use a 1 to 100 sample to water digestion, where pH measurements use a 1 to 1 sample to water ratio. Selected radionuclides were measured on some of the water digestion samples to determine the type and number of water soluble radionuclides. Inductively coupled plasma-atomic emission spectroscopy (ICP) and atomic absorption (AA) spectroscopy were also performed on some of the water digestion samples. These assays were performed to determine the amount of soluble metal cations (ICP) or arsenic, mercury, or selenium (AA). In many cases, these analytes were below the detection limits in the water digestion samples, suggesting that most of the analytes are not water soluble.

Acid digestion is a preparation method in which the sample is dissolved in a mixture of nitric and hydrochloric acids. This preparation brings most of the insoluble metals into a solution with a minimum amount of dilution, and usually is best for the detection of trace and some major metals. These properties are the reason that acid digestion generally is used as the sample preparation for the homogenization tests in SW-846-based environmental sampling. However, experience with Hanford-Site tank-waste matrices has shown that acid digestion does not always provide complete solubilization, and that a more rigorous dissolution preparation, such as fusion, may be necessary to get adequate quantitation. The analyses performed on this preparation were the ICP, gamma energy analysis (GEA), and AA analysis (the AA analysis used nitric acid only). IC analysis was not performed with the acid digestion preparation solution because that method introduces additional Cl^- or NO_3^- anions, confounding the results for that sample.

Analyses that were performed on fusion-prepared samples were ICP and GEA for radionuclides. Fusion dissolution analyses are assays performed on the sample matrix after it has been fused with potassium hydroxide in a nickel crucible and dissolved in acid. This preparation dissolves the entire sample, whereas other sample preparation procedures may not completely dissolve the sample matrix. However, one significant disadvantage of fusion preparation is that large amounts of potassium hydroxide are required to bring a sample into solution. Because of this high dilution factor, trace elements are less likely to be quantified correctly, if they are detected at all. Another limitation of the preparation method is if the sample contains substantial quantities of potassium or nickel, these analytes will not be quantifiable because the procedure uses potassium hydroxide and a nickel crucible. This limitation can be overcome using alternate preparation methods if potassium or nickel are analytes critical to interpretation of the data. Elements that occur in abundance, such as major metals, or that are highly insoluble are likely to be detected better by the fusion results than by any other sample preparation.

Generally, fusion dissolution is the preferred method of analyzing radionuclide content, with the exception of ^{14}C, ^{129}I, and ^{3}H (tritium). However, the sample preparation specified in the test instructions for ^{14}C (water digestion) probably is not best for the high-level waste

matrices. Difficulty with dissolving the sample with a water leach, and volatility associated with a fusion preparation, potentially will bias the ^{14}C results low for both sample preparation types if they are associated with the water insoluble solid materials, and similar difficulties are encountered for the other radionuclides mentioned. However, none of these analytes are expected to be significant contributors to the radionuclide content of the waste.

Major metal components that were detected well with fusion ICP analysis for tank 241-T-111 were calcium, chromium, iron, manganese, sodium, bismuth, and lanthanum. Phosphorous, sulfur, and silicon are non-metallic analytes detected by ICP. In the case of these elements, the fusion result is the preferred method of analysis because it is believed to provide more complete dissolution of the waste, and therefore, more complete quantitation of the analytes. Comparisons of these results with the IC results can provide insight to the solubility characteristics of the waste. Some of the primary radionuclides that are measured using this sample preparation are ^{237}Np, $^{239/240}Pu$, ^{90}Sr, ^{137}Cs, and ^{99}Tc. A total alpha and total beta count were performed on the fusion dissolution samples as well.

As previously noted, chemical and radiological analyses were done largely on core composites, and in these previous characterization efforts, the core composites were built using quantities of segments based on a proportion of the total weight of sample for the core (Winters et al. 1990a, Winters et al. 1990b). This method assumed that the sample obtained is representative of what is in the tank. However, when partially filled segments are obtained, this procedure assumes that the tank does not contain any waste in this area. Incomplete recovery for a segment probably is the result of sampling problems rather than voids in the waste. The approach used in this analysis effort was to composite equal quantities of the homogenized segment material and assume that whatever is obtained in a partial segment is representative of a whole segment. Some inaccuracies may be introduced from this method because of density differences between segments. However, the inaccuracies introduced from density differences probably are small. In general, those deviations are minimal compared to the other errors inherent in core sampling and analysis. If full segments are obtained for the entire core, and the homogenization procedure is satisfactory, there will be little difference between the two approaches.

4.5 ANALYTICAL METHODS

This section briefly describes the analyses used to characterize the waste in tank 241-T-111. The analyses were split between the Westinghouse 222-S Laboratory and PNL. Several of the analytical tests performed on the composites were also performed on the segments, but on a much more limited scope. There were no free liquids from cores 31 and 33, thus there are no separate liquid core composite results. However, in March 1994, a series of liquid grab samples were taken and analyzed for compatibility considerations (Carothers et al. 1994) before the start of stabilization. These results will be presented with the water digestion results and comparisons and conclusions will be made.

4.5.1 Physical and Rheological Tests

Physical tests completed at the 222-S Laboratory included particle size analysis, TGA, DSC, specific gravity, and percent water analyses. Duplicates were performed for the percent water analyses. The physical properties measured at PNL included weight percent solids, settling behavior, and weight percent dissolved solids. Rheological testing on these samples were performed at PNL and included shear strength and shear stress as a function of shear rate. Rheological properties were measured in duplicate. Table 4-3 lists the analytical methods used for physical and rheological testing. Three segments from Core 31 (segments 2, 4, and 8) were selected to perform the full suite of rheological and physical measurements, in addition to the particle size assay done on each segment. Viscosity, settling properties, fluid behavior, and shear strength were some of the primary characteristics investigated. The samples tested for these properties were not homogenized before analysis.

Table 4-3. Analytical Methods for Physical and Rheological Testing.

Analyte	Procedure
Particle size	T044-A-01712F
Thermogravimetric analysis	LA-560-112
Differential scanning calorimetry	LA-514-113
Specific gravity	LA-510-112
Percent water	LA-564-101
Rheology	PNL-ALO-501 PNL-ALO-502
Physical properties	N/A

Scanning TGA and DSC are useful in determining the thermal stability or reactivity of a material. TGA measures the mass of a sample while the temperature of the sample is increased at a constant rate. In DSC analysis, the heat absorbed/evolved over and above the usual heat capacity of the substance is measured while the substance is exposed to a linear increase in temperature. The gravimetric weight percent water was determined by drying the sample for 12 to 24 hours in an oven at 103 to 105 °C and measuring the difference in the weight of the sample.

4.5.2 Chemical and Radionuclide Constituent Analysis

Most of the chemical and radionuclide analyses were performed at the 222-S Laboratory. The uranium and plutonium isotopic analyses, however, were performed at PNL. Duplicate analyses were performed on every tank sample. Table 4-4 lists the analytical methods used (Winters et al. 1990a, Winters et al. 1990b).

Sample Homogenization

The segment and core composite samples were homogenized using a mechanical mixer before analysis. This was done so that aliquots removed for analysis would be representative of the entire segment or core composite. Aliquots of the homogenized tank waste from core 33, segments 1, 3, 5, 7, and 9, were taken to determine the efficacy of the homogenization procedure. The samples were split into duplicates, acid digested, and assayed by ICP and GEA. This procedure is done to determine if the degree of mixing achieved by the as-planned homogenization procedure was sufficient to achieve sample homogeneity. Since the homogenization samples are evaluated concurrently or after the other core samples, the results provide only an estimate of subsampling error (or variation). They were not used in this case to ensure that homogenization was achieved before analysis. However, after review of the results, it appears that homogenization of the samples was satisfactory.

4.5.3 Organic Constituent Analyses

All organic analyses of the samples from tank 241-T-111 were performed at PNL. An EPA contract-laboratory-procedure-type organics-speciation analysis was performed on the core composites. No levels of organic compounds above the contract required quantitation limit were found in any of the samples, and they were not expected to contribute to the sample matrix. The organic analyses performed were volatile organic analyses, semi-volatile organic analyses, total organic halides, and extractable organic halides. Duplicates were performed for all of these analyses. Table 4-5 lists the analyses and procedure numbers.

At the 222-S Laboratory, the initial total organic carbon assays were done using a furnace oxidation procedure of a water digested sample. At PNL, the total organic carbon content for the solids was determined using the hot persulfate method. That method dissolves a sample in a 90 °C+ sulfuric acid solution to liberate inorganic carbon (carbonate). $K_2S_2O_8$ is then added, and organic carbon is converted to CO_2, which is measured coulometrically. As stated in the "Executive Summary," these methods did not provide satisfactory results for the tank 241-T-111 waste samples. Later, furnace oxidation tests done at PNL gave results much higher than those from the 222-S Laboratory and more in line with the observed exothermic activity.

Table 4-4. Analytical Methods for Chemical and Radionuclide Analyses.

Analyte	Method	Procedure number
Hg	Cold vapor atomic absorption	LA-325-102
F^-, Cl^-, NO_3^-, NO_2^-, PO_4^{3-}, SO_4^{2-}	Ion chromatography	LA-533-105
CN^-	Distillation/spectrometric analysis	LA-695-101 LA-695-102
U	Laser fluorimetry	LA-925-106
Total Alpha Total Beta	Proportional counting	LA-508-101
^{238}Pu, $^{239/240}Pu$, ^{241}Am	Alpha spectrometry	LA-503-156
^{237}Np	Alpha proportional counting	LA-933-141
Total Cations	Inductively coupled plasma	LA-505-151
^{90}Sr	Beta proportional counting	LA-220-101
^{99}Tc ^{79}Se ^{14}C ^{3}H	Liquid scintillation	LA-438-101 LA-365-132 LA-348-104 LA-218-114
^{129}I ^{59}Ni	Low energy gamma analysis	LA-378-104 PNL-ALO-464
^{63}Ni	Liquid scintillation	PNL-ALO-474
^{154}Eu, ^{155}Eu, ^{241}Am, ^{137}Cs, ^{60}Co	Gamma energy analysis	LA-548-121
NO_2-	Spectrophotometry	LA-645-001
H+	pH	LA-212-103
As Se	Graphite furnace atomic absorption	PNL-ALO-214 PNL-ALO-215
Pu Isotopic	Fusion mass spectrometry	PNL-ALO-423 PNL-MA-597
U Isotopic	Mass spectrometry uranium laser	PNL-MA-597 PNL-ALO-445
TOC	Total organic carbon	LA-344-105 PNL-ALO-380 PNL-ALO-381
CO_3/C	Total inorganic carbon	LA-622-102

Table 4-5. Analytical Methods For Organic Analytes.

Analysis	Method	Procedure Number
Volatile organic analysis	Gas chromatography/mass spectrometry	PNL-ALO-335
Semi-volatile organic analysis	Gas chromatography/mass spectrometry	PNL-ALO-345
Extractable organic halides	Microcoulometric titration	PNL-ALO-320.2
Total organic halides	Microcoulometric titration	PNL-ALO-321

4.5.4 Segment-Level Analyses

The objectives of segment-level analyses are to provide (1) information as a function of depth pertaining to the overall waste energetics (water content and chemical reactivity) and (2) the particle size distribution and other general rheological information. To accomplish these goals, the limited suite of analyses listed in Table 4-6 were performed on each homogenized segment. These analyses were conducted using the analytical procedures identified in Tables I5-1 and I5-2 of WHC-EP-0210, Rev. 3 (Hill et al. 1991). In addition, where appropriate, the information obtained from the segment-level homogenization tests will be used to enhance the interpretation of the data.

Table 4-6. Segment-Level Analysis.

Direct	Acid dissolution*
Thermogravimetric analysis differential scanning calorimetry Wt% H_2O particle size**	Inductively coupled plasma (metals) gamma energy analysis (^{137}Cs) total alpha

*Acid dissolution assays were performed on the homogenization test segments.

**Particle size was done on non-homogenized segment material.

5.0 ANALYTICAL RESULTS: TANK 241-T-111

5.1 CHEMICAL ANALYSES

5.1.1 Analytical Results: Inductively Coupled Plasma-Atomic Emission Spectroscopy

Online inter-element corrections were performed for matrix interferences. The ICP has a built-in correction capability to adjust for moderate matrix interferences; however, there may be performance degradation on samples containing weight-percent quantities of iron, aluminum, or uranium. Corrections were made for moderate levels of aluminum, calcium, chromium, and magnesium in the samples. Corrections were made for high iron concentrations as well. Process or preparation blank values have not been subtracted from the results. In the water digestion and liquid grab sample assays, the single most prevalent element is sodium by at least an order of magnitude. Relative percent differences (RPDs) for water digestion results were high for some analytes (i.e. above the 20 percent acceptance criteria), but there was no consistent trend observed between cores 31 and 33.

In the fusion assays, some elements can appear to be at high concentrations because of the large dilution factors required for fusion samples. These high dilution factors propagate errors. Those analytes actually may be present only in concentrations marginally above the detection limit. For several analytes, higher quantitation was found in the acid digestion results. For purposes of determining inventories and making comparisons, the highest reliable average analytical result will be used between acid and fusion preparations.

In reviewing the data, a subtle bias or gradient was observed between the results for cores 31 and 33, with core 31 having slightly higher values overall than core 33. Although not readily discernable among the first tier analytes (sodium, bismuth, iron, and phosphorus), the difference between cores 31 and 33 is more evident in the second tier analytes (aluminum, lead, and magnesium). The RPDs between the individual core composite samples and their replicates were small, suggesting that the gradient is real and not an analytical artifact, however, this observation could be the result of the compositing procedure. There were nine segments used in the core 33 composites, but only eight segments in the core 31 composites (segment 6 was absent in core 31). Furthermore, sample variability may contribute or be wholly responsible for the observed difference.

RPDs for most elements were within the 20-percent acceptance criteria for acid and fusion results, and generally were less than 10 percent for the major analytes. Potential sample contamination for boron and silicon exists because of the caustic nature of the samples and the glass vials used to store the samples in the laboratory; however, silicon routinely demonstrated a low bias. Calcium and magnesium for blank and spike recovery results may have been biased high by the powder used on the analysts' gloves when performing the assays. With the small sample sizes used in the assay, even trace amounts of powder have

the potential to impact the analyses. Low spike recoveries were noted for several analytes for differing reasons. Silver recoveries are commonly low because of the precipitation of silver chloride in the sample digestion. Poor spike recoveries of iron, magnesium, and calcium accompany high preparation blank results, but the overall correlation is poor. Spike failures frequently are noted for major elements when the spike concentration is insignificant compared to the analyte concentration in the waste matrix. Spike and standard results outside the acceptance criteria for these analytes do not necessarily invalidate the sample results for the ICP in general, or for those analytes in particular. Individual analyte failures need to be evaluated on a case by case basis. All of these behaviors could affect, and are considered in the interpretation of the results.

The detection limit for each analyte is provided for comparison with the results to aid in interpretation. All ICP analytes are reported in the data tables; however, those consistently contributing significant (i.e generally greater than approximately 0.2 weight percent) amounts to the composition of the waste matrix generally are relevant to bulk characterization. The fusion/acid ratio, which can be compared in the table, for most analytes indicates near total dissolution for the acid digestion assay. Average values for the analytes are reported to three significant figures. The full range of ICP analytical results can be found in the full data packages (McKinney et al. 1993). All reported concentration values are based on grams of wet sample, unless otherwise specified. Table 5-1 provides ICP analyte concentration information on the core composites as a function of the sample preparation. Table 5-2 provides ICP analyte concentrations as a function of depth for Core 33. Table 5-3 compares the water digestion core composite ICP values with the results from the grab sample.

Core 31

The most significant analytes measured by the water digestion of the core composite were sodium and phosphorous (probably as a soluble phosphate), and sulfur (probably as a soluble sulfate). Much smaller amounts of iron, chromium, and silicon also were measured. RPDs were elevated for these samples (between 10 and 20 percent), but were generally within the 20-percent acceptance criteria. For analytes with results outside the acceptance criteria, no clear trend between the two composites can be established. The water digestion result for core 31, composite 1 had several analytes with high RPDs, many of which are significant contributors to the waste: iron, lead, manganese, silver, bismuth, lanthanum, and strontium. Core 31, composite 2 had few analytes with results outside the acceptance criteria: barium, calcium, lead, and vanadium. All of the analytes noted are largely insoluble and that characteristic probably is contributing to the observed variability.

The results from the acid digestion preparation of the core composite samples had sodium, phosphorous, sulfur, calcium, chromium, iron, manganese, bismuth, and lanthanum as major analytes. RPDs are very good in general for most of the major analytes (generally between 5 and 10 percent), well within the 20 percent acceptance criteria. Analytes outside the acceptance criteria for core 31, composite 1 were antimony and boron (56 percent and 27 percent, respectively). However, neither of those analytes are substantial contributors to the waste matrix, and for analytes near the detection limit, reproducibility is not expected.

Table 5-1. ICP Cations. (4 pages)

Analyte	Acid-water digestion	Fusion digestion	Prep type	Core 31 comp. 1	Core 31 comp. 2	Core 33 comp. 1	Core 33 comp. 2
	Detection limit	Detection limit		Average concentration	Average concentration	Average concentration	Average concentration
	(μg/g)	(μg/g)		(μg/g)	(μg/g)	(μg/g)	(μg/g)
Al	2.4		Water	6.71	10.3	15.5	11.0
			Acid	584	705	472	405
		12.0	Fusion	644	693	484	459
Sb	17.7		Water	17.7	17.7	17.7	17.7
			Acid	30.4	36.5	35.9	22.6
		85.5	Fusion	88.6	88.3	109	88.4
As	3.0		Water	3.0	3.0	2.99	3.0
			Acid	3.15	2.92	3.45	3.06
	3.3		GFAA[1]	3.3	3.3	3.3	3.2
		15.0	Fusion	15.0	15.0	15.0	15.0
Ba	.3		Water	0.305	0.416	0.547	0.516
			Acid	57.0	64.9	66.8	87.3
		1.5	Fusion	58.8	60.6	65.4	73.7
Be	0.1		Water	0.10	0.10	0.10	0.10
			Acid	0.105	0.097	0.117	0.104
		0.5	Fusion	0.501	0.499	0.499	0.499
Cd	.4		Water	0.40	0.40	0.4	0.4
			Acid	7.22	7.86	4.4	3.72
		2.0	Fusion	8.25	10.7	6.42	7.17
Ca	4.4		Water	50.8	61.6	66.4	67.5
			Acid	2,200	2,480	1,490	1,350
		22.0	Fusion	2,760	2,660	2,220	2,050
Cr	0.9		Water	209	229	224	211
			Acid	1,860	1,840	2,060	2,140
		4.5	Fusion	1,890	1,700	1,790	1,820

[1]GFAA: Graphite furnace atomic absorption

Table 5-1. ICP Cations. (4 pages)

Analyte	Acid-water digestion	Fusion digestion	Prep type	Core 31 comp. 1	Core 31 comp. 2	Core 33 comp. 1	Core 33 comp. 2
	Detection limit	Detection limit		Average concentration	Average concentration	Average concentration	Average concentration
	(μg/g)	(μg/g)		(μg/g)	(μg/g)	(μg/g)	(μg/g)
Co	0.8		Water	0.8	0.825	0.821	0.825
			Acid	3.4	7.16	3.13	2.91
		4.0	Fusion	10.1	10.8	13.3	11.8
Cu	.4		Water	0.4	0.4	0.4	0.4
			Acid	25.2	79.6	16.4	13.0
		2.0	Fusion	36.3	34.2	22.1	24.6
Fe	1.0		Water	79.6	140	132	159
			Acid	19,200	20,000	17,500	17,300
		5.0	Fusion	20,500	19,600	15,900	16,100
Pb	6.2		Water	7.05	7.93	6.24	6.19
			Acid	475	543	201	168
		31.0	Fusion	440	484	267	269
Mg	0.3		Water	2.94	3.95	3.84	3.83
			Acid	435	479	305	290
		1.5	Fusion	438	443	268	272
Mn	0.2		Water	14.7	25.1	25.4	33.8
			Acid	6,190	6,140	6,710	6,280
		1.0	Fusion	6,380	5,940	6,220	6,590
Ni	1.7		Water	1.7	1.7	1.7	1.7
			Acid	151	157	110	108
		8.5	Fusion	NR	NR	NR	NR
K	11.2		Water	734	783	712	648
			Acid	1,100	1,210	1,210	1,020
		56.0	Fusion	NR	NR	NR	NR
Se	7.6		Water	7.6	8.01	7.58	7.59
			Acid	7.98	7.4	10.3	7.79
	1.5		GFAA	1.5	1.5	1.5	1.5
		38.0	Fusion	38.0	37.9	38.0	38.0

Table 5-1. ICP Cations. (4 pages)

Analyte	Acid-water digestion	Fusion digestion	Prep type	Core 31 comp. 1	Core 31 comp. 2	Core 33 comp. 1	Core 33 comp. 2
	Detection limit	Detection limit		Average concentration	Average concentration	Average concentration	Average concentration
	(μg/g)	(μg/g)		(μg/g)	(μg/g)	(μg/g)	(μg/g)
Ag	0.5		Water	0.639	1.16	0.553	0.499
			Acid	203	227	44.3	30
		2.5	Fusion	214	221	39.5	37.1
Na	3.1		Water	34,000	35,000	30,800	32,000
			Acid	37,600	38,700	35,000	36,300
		15.5	Fusion	39,800	39,000	33,900	35,200
V	0.5		Water	0.5	0.707	0.5	0.8
			Acid	12.7	21.4	13.9	9.99
		2.5	Fusion	12.1	16.5	15.3	14.7
Zn	0.3		Water	0.3	0.3	0.3	0.3
			Acid	79.4	101	44.2	35
		1.5	Fusion	104	106	105	110
Bi	7.5		Water	115	191	231	270
			Acid	23,600	23,300	28,500	28,400
		37.5	Fusion	20,900	20,100	26,500	26,700
B	0.6		Water	3.31	3.19	5.54	4.25
			Acid	27.1	23.4	29.4	32.2
		3.0	Fusion	3.0	2.99	4.84	4.84
Ce	10.1		Water	10.1	10.1	10.1	10.1
			Acid	32.6	28.6	37.8	35.8
		50.5	Fusion	50.6	50.4	50.4	50.4
La	1.4		Water	6.02	8.52	13.8	15.8
			Acid	3,720	3,620	4,640	4,890
		7.0	Fusion	3,690	3,410	4,510	4,810
P	5.8		Water	5,760	5,960	5,300	5,700
			Acid	10,100	9,960	9,860	11,300
		29	Fusion	11,600	11,100	9,070	9,910
Si	1.3		Water	438	560	669	620
			Acid	482	471	528	394
		6.5	Fusion	5,960	5,840	5,460	5,410

Table 5-1. ICP Cations. (4 pages)

Analyte	Acid-water digestion	Fusion digestion	Prep type	Core 31 comp. 1	Core 31 comp. 2	Core 33 comp. 1	Core 33 comp. 2
	Detection limit	Detection limit		Average concentration	Average concentration	Average concentration	Average concentration
	(μg/g)	(μg/g)		(μg/g)	(μg/g)	(μg/g)	(μg/g)
Sr	0.3		Water	1.21	2.13	2.18	2.34
			Acid	282	280	305	334
		1.5	Fusion	303	280	291	317
S	2.7		Water	1,190	1,200	1,060	1,140
			Acid	1,230	1,260	1,140	1,220
		13.5	Fusion	1,350	1,310	1,080	1,160
Sn	1.6		Water	1.6	1.6	1.6	1.6
			Acid	4.21	2.44	1.81	1.61
		8.0	Fusion	8.01	7.98	7.99	7.99
Ti	0.4		Water	0.4	0.4	0.4	0.4
			Acid	29.4	33	8.9	6.46
		2.0	Fusion	72.9	72.4	22.3	24.1
Zr	NR		Water	0.8	0.799	0.798	0.798
			Acid	0.84	0.778	0.913	0.816
		NR	Fusion	4.00	3.99	4.00	4.00
Hg	0.125	NR	CVAA[2]	1.59	1.83	1.20	1.08

NR = Not reported

Table 5-2. Tank 241-T-111 Core 33 ICP Selected Analyte Trending as a Function of Depth (Acid prep on segments).

Segment	Ca (μg/g)	Cr (μg/g)	Fe (μg/g)	Mn (μg/g)	Ni (μg/g)	Na (μg/g)	Bi (μg/g)	La (μg/g)	P (μg/g)	Si (μg/g)	S (μg/g)
1	4,800	490	17,300	23,900	240	22,400	760	3	4,400	380	800
3	1,100	1,200	11,700	3,800	70	25,800	24,200	3,900	4,800	430	720
5	1,300	2,000	16,100	2,800	90	32,100	33,400	5,100	9,100	400	1,100
7	1,100	2,500	18,100	4,200	70	36,000	34,700	4,900	12,200	450	1,200
9	950	2,000	16,600	4,600	90	40,700	24,100	4,200	15,300	450	1,400

[2]CVAA: Cold vapor atomic absorption

Table 5-3. Grab Sample/Water Digestion Data--ICP Average Values.

Analyte	Grab sample avg. concentration (μg/g sample)	Core 31, comp. 1 (μg/g sample)	Core 31, comp. 2 (μg/g sample)	Core 33, comp. 1 (μg/g sample)	Core 33, comp. 2 (μg/g sample)
Ca	< DL	51	62	66	68
Cr	230	210	230	220	210
Fe	< DL	80	140	130	160
Ni	< DL	15	25	25	34
Na	24,800	34,000	35,000	30,800	32,000
Bi	< DL	120	190	230	270
La	< DL	6	9	14	16
P	3,200	5,800	6,000	5,300	5,700
Si	60	440	560	670	620
S	750	1,200	1,200	1,100	1,100

< DL = below detection limit

This behavior is true in general for analytes with these characteristics. The silicon RPD is marginal at 19.26 percent, but acceptable. For core 31, composite 2, cobalt, copper, silicon, and tin were outside the acceptance criteria. Again, cobalt, copper, and tin were not significant contributors to the waste, and thus have little influence on the interpretation of the data. The only clear trend for this assay is for silicon. The variation observed for silicon was attributed to the solubility of the waste matrix (i.e. the waste is not completely solubilized by the acid), and therefore, the fusion results will be reviewed to quantitate silicon. Based on a ratio of the acid and water digestion results, most of the analytes are not water soluble, except as noted earlier, however, approximately 10 percent of the chromium is water soluble.

The results from the fusion preparation core composite had sodium, phosphorous, bismuth, manganese, lanthanum, silicon, iron, calcium, and chromium as major analytes. Nickel was detected in substantial quantities, but the results are considered unreliable because of sample contamination (the method uses a nickel crucible to perform the fusion), and nickel was not detected in significant quantity in the acid digestion assay. RPDs were quite low, generally less than eight percent for most analytes, demonstrating excellent agreement. The only analyte with an RPD outside the acceptance criteria for core 31, composite 1 was cadmium, which is not a large contributor to the waste and is near the detection limit. The only analytes with excessive RPDs for core 31, composite 2 were cadmium and nickel. Both of these analytes have problems associated with them that make these results suspect for this test method (proximity to the detection limit for cadmium and cross-contamination from the

crucible for nickel). Comparisons with the acid digestion results indicate that the samples were well dissolved by the acid preparation, but in some cases, and with silicon especially, the fusion dissolution was necessary to obtain reliable, quantitative results for the analyte.

Core 33

Sodium, phosphorus (probably as a soluble phosphate), and sulfur (probably as a soluble sulfate) were the most significant analytes measured by the water digestion of the core composite. Much smaller amounts of iron, chromium, and silicon were the other main analytes. RPDs were elevated for these samples (between 10 and 20 percent), but generally were within the 20 percent acceptance criteria. For analytes with results outside the acceptance criteria, no clear trend between the two composites or between cores can be established firmly, but there was some correspondence between the cores and their respective composites (i.e. there was some agreement between cores 31 and 33 composite 1, etc.), but the connection was quite tenuous. The water digestion result for core 33, composite 1 had several analytes with high RPDs, many of which are significant contributors to the waste. These analytes are aluminum, barium, iron, manganese, bismuth, and lanthanum. For core 33, composite 2, only calcium and vanadium were outside the acceptance criteria. The degree of variability observed for this particular sample preparation is not unexpected. Most of these analytes probably are in a form that is not readily water soluble and, depending on the sample matrix exposure to the solution media, substantial differences may be observed.

The results from the acid digestion preparation of the core composite samples are quite similar to core 31. They had sodium, phosphorous, sulfur, calcium, chromium, iron, manganese, bismuth, and lanthanum as major analytes, the RPDs decline significantly in comparison to the water digestion results, both in the number of analytes outside the acceptance criteria and the overall magnitude of the RPDs themselves. The RPDs are very good in general for most of the major analytes (between 5 percent and 10 percent), well within the 20 percent acceptance criteria. Analytes outside the acceptance criteria for core 33, composite 1 were antimony and selenium (88.5 percent and 33.0 percent, respectively). For core 33, composite 2, antimony and silicon were outside the acceptance criteria (31.2 percent and 48.7 percent, respectively). The results for antimony and selenium are not surprising. They are not far above their respective detection limits and neither is a substantial contributor to the waste matrix. The silicon RPD result is not unexpected, because the waste has solubility properties that make it resistant to acid digestion, making this assay marginal at best. Based on a ratio of the acid and water digestion results, most of the analytes are not water soluble, except as noted earlier; however, approximately 10 percent of the chromium is water soluble. In this case, for several analytes, some consistency is seen between composite replicates and cores. As noted earlier, core 33 sample results are, in several cases, about 25 percent or more lower than core 31. Significant changes in analyte concentration were observed in the ICP acid digestion results as a function of depth for core 33. The results are shown in Table 5-2. The changes observed for some analytes are notable, ranging from factors of 3 and 4 for calcium, chromium, and phosphorous to orders of magnitude for manganese, bismuth, and lanthanum. These swings

in concentration suggest the waste is heterogenous on a tank-wide scale and that the waste in the tank is layered.

Properties and major analytes for the fusion digestion results are similar to core 31, however the differences observed between the analytical results of cores 31 and 33 become much less consistent with this group of assay results. RPDs were generally low, less than 12 percent, with most analyte results substantially less than that. Antimony, calcium, and boron had RPDs outside the acceptance criteria for core 33, composite 1. In core 33, composite 2, cobalt and nickel, which are not large contributors to the waste, had RPDs outside the acceptance level and antimony, boron, and cobalt are near their respective detection limits. Several of these analytes have problems associated with them that make these results suspect for this test method. However, the variation seen for calcium is not expected and there is no reason for its behavior. In this case, no consistency was observed between composites or cores, except for nickel in cores 31 and 33, composite 2, and the nickel results for this test method are suspect.

5.1.2 Analytical Results--Anion Assays

Core 31 Ion Chromatography Results:

Major anions detected are NO_3^- and PO_4^{3-}, with smaller, but still substantial amounts of F^- and SO_4^{-2}. Nitrite and chloride are minor contributors to the waste. Indeed, the IC results for nitrite are considered an estimated result; however, the magnitude and range of concentration is confirmed by a spectrophotometric analysis. All RPDs for quantitated results are well within the 20 percent acceptance criteria, and generally are less than 10 percent. Comparisons of phosphorous and sulfur water-digestion ICP results with ion-chromatography results for PO_4^{3-} and SO_4^{-2} give good agreement (RPDs are less than 10 percent) and show that phosphorous is about 48 to 56 percent soluble (as phosphate) and sulfur is about 90 to 100 percent soluble (as sulfate). Table 5-4 illustrates the comparison between the water digestion ICP and IC results, and the relationship to the total amount of phosphorous and sulfur in the matrix. Table 5-5 presents the summary results for the IC analytes and other anions.

Core 33 Ion Chromatography Results:

Major analytes were the same as those found in core 31. RPDs for the minor analytes, F^-, Cl^-, and NO_2^-, were much higher in composite 1 than in composite 2, or in either of core 31's composites, exceeding 15 percent, but within the 20 percent acceptance criteria. Core 33, composite 2 had superior RPDs, all were less than 8 percent. Comparison of the phosphorous and sulfur water-digestion ICP results with IC for PO_4^{3-} and SO_4^{-2} gives good

Table 5-4. Comparison of Ion Chromatography and Water Digestion ICP Results for Selected Analytes.

Sample ID	PO_4^{3-} Concentration (μg/g)		PO_4^{3-} RPD	SO_4^{-2} Concentration (μg/g)		SO_4^{-2} RPD	PO_4^{3-} Solubility*		SO_4^{-2} Solubility*	
	(IC)	(ICP.w)		(IC)	(ICP.w)		(IC)	(ICP.w)	(IC)	(ICP.w)
Core 31-C1	16,200	17,300	6.7	3,690	3,570	-3.3	50.8	54.2	100.4	97.1
Core 31-C2	17,400	17,900	2.8	3,740	3,600	-3.7	54.5	56.1	101.8	97.9
Core 33-C1	13,600	15,900	16.9	3,290	3,420	-3.3	42.6	49.8	89.5	93.1
Core 33-C2	15,100	17,100	13.2	3,470	3,660	-1.4	47.3	53.6	94.4	99.6

*Solubility is a ratio of the IC/ICP.w result to 31,900 μg/g PO_4^{3-} and 3,675 μg/g SO_4^{2-}, the tank average of the converted fusion results
ICP.w = Notation for ICP water digestion result

Table 5-5. Anion Results--Composite Data (water leach).

Analyte	Detection limit (μg/g)	Core 31 (μg/g)		Core 33 (μg/g)		Grab sample (μg/g)
		Composite 1	Composite 2	Composite 1	Composite 2	Average
NO_3^-	100	44,300	43,800	36,900	40,100	30,300
PO_4^{3-}	100	16,200	17,400	13,600	15,100	8,400
SO_4^{2-}	100	3,690	3,740	3,290	3,470	2,900
Cl^-	10	470	497	401	432	490
F^-	10	3,090	3,130	1,370	1,630	2,100
NO_2^-	50	952	525	878	817	1,320 (IC)
TOC*	500	3,490	3,990	2,000	3,000	420
TIC*	500	650	824	823	950	670
Free OH^-	NM	NM	NM	NM	NM	3,000
pH*	NA	10.18	9.93	10.05	9.77	11.65
NH_3/ NH_4^+ *	4,500	< DL	< DL	< DL	< DL	400

Table 5-5. Anion Results--Composite Data (water leach).

Analyte	Detection limit (μg/g)	Core 31 (μg/g)		Core 33 (μg/g)		Grab sample (μg/g)
		Composite 1	Composite 2	Composite 1	Composite 2	Average
Direct Cyanide[1]	5	< DL	< DL	< DL	< DL	< DL

NM = No measurement NA = Not applicable
< DL = Below detection limit

Note: All IC results are obtained from a water leach preparation and are reported on a wet basis.

[1]Direct Cyanide, NH_3/NH_4^+, pH, total organic carbon (TOC), and total inorganic carbon (TIC) are not IC analyses, but are grouped with the anions for convenience. NO_2^- results reported are from spectrophotometric methods. At the 222-S Laboratory, TOC and TIC assays were done on water digested samples. When 325 performed segment level assays for these analytes, they did them on direct solid samples.

agreement, however, phosphorous shows a higher, but still acceptable variability, with RPDs of 13 to 17 percent, than sulfur as SO_4^{-2}, with RPDs of -1.4 to -3.3. Phosphorous is approximately 50 percent soluble as phosphate, whereas sulfur as sulfate is almost entirely soluble. Table 5-4 illustrates the comparison between the water digestion ICP and IC results, and the relationship to the total amount of phosphorous and sulfur in the bulk tank matrix. Note the ICP results are converted to phosphate and sulfate for comparison.

Core 31 and 33 Additional Anion Results:

- Nitrite, as determined from spectrophotometry, has good agreement between composites and acceptable RPDs. Concentrations between cores are observed to agree well also.

- The pH of the solids is measured using a water dilution of a solids aliquot. The pH of the mixture is measured and reported. The results for tank 241-T-111 waste from this method are consistent, ranging from 9.8 to 10.5, but are of limited utility because the sample preparation and assays only marginally represent the conditions in the tank. The pH as determined from a grab sample taken in 1994 (see Appendix C) is between 11.5 and 11.8, and is considered more reliable and more representative of the waste tank conditions.

- Ammonia/ammonium results for the solids were all below the detection limit for the method. This is not unexpected. Over time, ammonia probably was slowly released to the vapor space and removed by passive ventilation. A small amount of this analyte remains in the liquids, but the liquid is being removed.

- Total organic carbon (TOC) results indicate a substantial difference between cores 31 and 33 (core 31's TOC concentration is 33 percent higher than core 33's), but results for the individual core composites are very consistent. Core 31 composite 1 and composite 2 RPDs are negligible. Core 33, composite 1 and composite 2 RPDs are low, well within the acceptance criteria, but noticeable.

- Total inorganic carbon (TIC) results were a factor of three to four times lower than the TOC results and were near the detection limit. Therefore, they are not considered wholly reliable, however the results did provide acceptable reproducibility. TOC results are also considered questionable, especially when contrasted with the calorimetry results from segment-level data from both cores (segments 1-3 particularly), and a furnace oxidation value of 4.1 weight percent (dry), for core 33, segment 2 (Baldwin 1994).

The gradient observed in the ICP results remains noticeable for the anions, especially for TOC and F^-, but the overall effect is much less pronounced. This effect is expected and ascribed to the nature of the assay (i.e. water digestion assay results for soluble analytes in a mostly water matrix are expected to be reasonably homogeneous). TOC and F^- probably are present in insoluble forms, and thus are not as amenable to detection and are more likely to exhibit variations in concentration.

5.2 ANALYTICAL RESULTS--RADIOCHEMISTRY

5.2.1 Radiochemistry Assays--General Comments

Analyses appear to be consistent. Total beta measurements calculated using ^{60}Co detector efficiencies are largely in agreement with the sum of the major beta emitters, ^{90}SrY and ^{137}Cs [i.e. beta emission values must be adjusted by 1.42 and 1.51, respectively, the ratio of ^{90}SrY and ^{137}Cs to ^{60}Co detector efficiencies (Winters 1991)]. However, the total alpha values show only marginal agreement with the sum of the neptunium, plutonium, and americium/curium values. This behavior was attributed to the low activity of the samples and a recently discovered equipment problem. Technicians at the 222-S Laboratory identified an electronic problem with their alpha detection system involving the degree of discrimination between beta and alpha emissions. These two conditions are thought to contribute to the observed high bias of the total alpha measurements. Detection and quantitation of ^{137}Cs and most other radionuclides was based on the presumed ability of the fusion sample preparation to completely dissolve the waste. Water preparation samples were

done on selected analytes as directed in the test plan. GEA measurements show good agreement with alpha energy analysis for ^{241}Am. GEA analytical values are not corrected to account for decay, however most of the radionuclides present are long-lived enough and low enough in concentration so that any correction at this point would be modest.

5.2.2 Gamma Energy Analysis Results

The GEA data from the replicate samples of the core composites for cores 31 and 33 prepared by caustic fusion agree reasonably well with each other (RPDs generally were within 10 percent). However, there is a discernable gradient between cores 31 and 33 for ^{137}Cs. This follows the general pattern observed for several other analytes, but in this case ^{241}Am does not appear to be affected. Review of the segment-level homogenization data for core 33 indicates that in general, the ^{137}Cs content is lowest in the bottom segments and highest in the upper segments, increasing in concentration from bottom to top. This behavior indicates that the ^{137}Cs is concentrated in the upper portion of the tank. However, the overall radionuclide content of tank 241-T-111 is extremely low. The ^{154}Eu and ^{155}Eu content is above the detection limits only in segments 1 and 3, suggesting that these isotopes are in the upper portions of cores 31 and 33. However because of the limited segment level data, too many conclusions should not be drawn from these observations. Grab sample results for ^{137}Cs is more than a factor of four lower than those obtained from fusion assays, indicating that the radionuclides, ^{137}Cs in particular, are very insoluble. Agreement between the same top and bottom aliquots in the homogenization check samples prepared by acid digestion were very good for analytes above the detection limit, with RPDs generally less than 10 percent and usually much less than that, indicating sample homogeneity and/or relatively complete dissolution.

5.2.3 Total Alpha Analysis and Uranium Assay

Total alpha, plutonium, ^{237}Np, ^{241}Am, and ^{244}Cm analyses were performed on the fusion prepared samples of the core composites and selected assays were done on the liquid grab sample. Total alpha measurements were also performed on the homogenization check samples from segments 1, 3, 5, 7, and 9 from core 33. The total alpha activity was determined by drying a small aliquot of prepared sample on a counting plate and assayed with an alpha proportional counter. The plutonium and americium fractions were separated by solvent extraction or ion exchange and similarly counted.

The plutonium analyses are reported as total alpha $^{239/240}Pu$. The process blank was two to three orders of magnitude lower that the samples, indicating little contamination occurred during sample preparation. The total alpha concentration frequently tends to be somewhat lower than the sum of the individual alpha emitters. The difference is probably caused by absorption by the salt residue on the counting mounts. However, in this case, substantial differences are observed between the total alpha measurements and the sum of the individual alpha emitters. The total alpha emissions are believed to be lower than the measurement

indicates because of a bias caused by beta emissions confounding the detector. The activity of the samples is so low that the offset used to discriminate between alpha and beta plateaus was not sufficient to provide accurate readings. Furthermore, analyses from PNL indicate a potential low bias for plutonium in the samples. The degree of discrepancy ranges from over a factor of two to nearly a factor of five. This degree of disagreement warrants further attention. Isotope content was determined by thermal-ionization mass spectroscopy. Little variation in the plutonium isotopic composition was observed between cores. Total alpha measurements vary widely as a function of depth, but exhibit a general decreasing trend the deeper the samples are in the waste. Segment 5 was an exception to this trend. The anomalous total alpha reading in segment 5 may be indicative of a process upset or change in waste management operations, such as the 5-6 waste that Anderson (1990) notes was co-mingled with the 2C waste in 1952.

Uranium measurements were obtained from laser fluorimetry of the fusion-prepared sample from the two core composites and their replicates. The assays show good agreement between duplicates for each individual core composite, but there is not good agreement between the core 31 and 33 replicates. Additionally, the gradient observed in the other assays is not evident here. Furthermore, analyses from PNL indicate a potential low bias for uranium in the samples. The degree of discrepancy is nearly a factor of two for corresponding samples, and thus warrants further study. Differences in concentration as a function of the water content of the samples is not deemed to be an issue because the additional characterization work done in resolving the energetics question indicates that little or no water is lost while the samples are stored. Time lag is also not considered relevant, since the difference in time between the two assays was small in comparison to the half-lifes involved. No general trend of the uranium concentration as a function of depth can be established because there is no segment-level data for this analyte.

5.2.4 Total Beta

Total beta, ^{90}Sr, and ^{99}Tc analyses were performed on the liquid grab sample and fusion prepared samples of the core composites. The total beta activity was determined by drying a small aliquot of prepared sample on a planchet and assaying it with a beta proportional counter. The ^{90}Sr fraction was separated by solvent extraction or ion exchange and counted. The ^{99}Tc fraction was separated similarly, but assayed using liquid scintillation. There generally is good agreement (RPDs were less than 10 percent) between duplicates, and preparation blank beta activities are orders of magnitude lower than the levels found in the samples, again indicating little contamination from preparation in the hot cell. Most of the beta activity in the tank samples is from ^{90}SrY and ^{137}Cs. There is also a trace of ^{99}Tc. The ^{90}SrY, ^{99}Tc, and ^{137}Cs data are consistent between the fusion core composites and their replicates, but in this case the gradient between cores 31 and 33 is observed for ^{90}Sr and ^{137}Cs. There is no data to determine if ^{90}Sr content varies as a function of depth.

Tables 5-6, 5-7, 5-8, and 5-9 show the average radionuclide concentrations found in the core composite samples. Table 5-10 shows average fission product concentration and total alpha concentrations as a function of depth.

Table 5-6. Consolidated Radionuclide Concentration Results for 241-T-111.

Analyte method	Detection limit	Core 31, composite 1	Core 31, composite 2	Core 33, composite 1	Core 33, composite 2
GEA analytes	(μCi/g)	(μCi/g)	(μCi/g)	(μCi/g)	(μCi/g)
^{60}Co.f	(DL = 4.07E-04)	< DL	< DL	< DL	< DL
^{137}Cs.f	(DL = 3.70E-04)	0.211	0.237	0.114	0.103
^{154}Eu.f	(DL = 1.20E-03)	0.00108	0.00324	< DL	< DL
^{155}Eu.f	(DL = 5.95E-04)	< DL	< DL	0.00307	< DL
^{241}Am.f	(DL = 1.14E-04)	0.0459	0.0409	0.0387	0.0443
Beta emitters					
Total beta.f	(DL = 9.35E-02)	20.6	21.5	9.59	8.83
Total beta	Calculated	20.7	21.5	10.5	9.9
^{3}H.w	(DL = 3.15E-04)	< DL	< DL	< DL	< DL
^{14}C.w	(DL = 2.25E-04)	< DL	< DL	< DL	< DL
^{59}Ni.a	(DL= 4.00E-06)	8.3E-05	3.33E-05	4.44E-05	4.07E-05
^{63}Ni.a	(DL= 4.00E-06)	0.0093	0.00358	0.00545	0.00459
^{79}Se.f	(DL = 1.40E-04)	< DL	< DL	< DL	< DL
^{90}Sr.f	(DL = 2.15E-03)	7.16	7.43	3.65	3.43
^{99}Tc.f	(DL = 4.60E-03)	0.00514	0.00473	0.0114	0.0104
^{129}I.f	(DL = 6.40E-03)	< DL	< DL	< DL	< DL

Table 5-6. Consolidated Radionuclide Concentration Results for 241-T-111.

Analyte method	Detection limit	Core 31, composite 1	Core 31, composite 2	Core 33, composite 1	Core 33, composite 2
Uranium and transuranics					
Total U.f (μg/g) *(325)*	(DL = 3.40E-02)	2,180 *4,000*	3,880 *5,200*	3,180 *4,500*	1,950 *3,500*
Total alpha.f	(DL = 7.01E-03)	0.358	0.359	0.377	0.379
Total alpha	Calculated (Range)	0.179-0.669	0.179-0.608	0.172-0.357	0.195-0.416
^{237}Np.f	(DL = 3.40E-02)	< DL	< DL	< DL	< DL
^{238}Pu.f	(DL = 1.00E-02)	< DL	< DL	< DL	< DL
$^{239/240}$Pu.f *(325)*	(DL = 3.50E-03)	0.138 *0.628*	0.136 *0.565*	0.134 *0.319*	0.147 *0.368*
^{241}Am.f	(DL = 3.00E-03)	0.0414	0.0431	0.0382	0.0478
^{244}Cm.f	(DL = Not Reported)	< DL	< DL	< DL	< DL

< DL = below detection limit
Analyte.f = fusion digestion
Analyte.a = acid digestion
Analyte.w = water digestion

Total beta calculated determined by:
1.42 (2)(^{90}Sr) + 1.51 (^{137}Cs)
Total alpha calculated determined by:
$^{239/240}$Pu + ^{241}Am

Table 5-7. Core Composite Uranium.

Core number	U_{FL} (222-S) (μg/g)	U_{FL} (325) (μg/g)	^{238}U mass percent	^{235}U mass percent
Core 31, composite 1	2,180	4,000	99.3074	0.6755
Core 31, composite 2	3,880	5,200	99.3098	0.6761
Core 33, composite 1	3,180	4,500	99.3125	0.6761
Core 33, composite 2	1,950	3,500	99.3161	0.6717

FL = Uranium measurement by laser fluorimetry.
222-S Assay date: 4/92
325 Assay date: 9/92

Table 5-8. Plutonium Concentration and Isotopic Distribution.

Core number	Total Pu α (222-S) (μCi/g)	Total Pu α (325) (μCi/g)	^{238}Pu mass percent	^{239}Pu mass percent	^{240}Pu mass percent	^{241}Pu mass percent	^{242}Pu mass percent
Core 31, C1	0.138	0.628	0.005	96.7199	3.2109	0.0352	0.0151
Core 31, C2	0.136	0.565	0.0105	96.6351	3.2834	0.0496	0.0215
Core 33, C1	0.134	0.319	0.004	96.7540	3.1046	0.1071	0.0683
Core 33, C2	0.147	0.368	0.0105	96.5499	3.3436	0.0621	0.0337

222-S Assay date: 4/92 C1 = Composite 1
325 Assay date: 9/92 C2 = Composite 2

Table 5-9. Radiochemical Analyses of Grab Sample.

Analyte	Average concentration (μCi/mL)	Average concentration (μCi/g)[1]
^{90}Sr	0.001	0.001
^{137}Cs	0.090	0.087
$^{239/240}$Pu	6.83E-05	6.58E-05
Total Alpha	0.0024	0.0023
Total Beta	0.233	0.224

[1]Density of 1.036 g/mL used for conversion.

Table 5-10. Tank 241-T-111 Core 33 Radionuclide Analyte Trending as a Function of Depth (Acid prep on segments).

Segment	^{137}Cs (μCi/g)	^{154}Eu (μCi/g)	^{155}Eu (μCi/g)	^{241}Am (μCi/g)	^{60}Co (μCi/g)	Total alpha (μCi/g)
1	0.403	0.021	0.027	0.138	0.006	0.649
3	0.140	9.05E-04	0.002	0.014	0.0005	0.166
5	0.088	< DL	< DL	0.020	< DL	0.527
7	0.023	< DL	< DL	0.014	0.0005	0.350
9	0.013	< DL	< DL	0.050	< DL	0.262

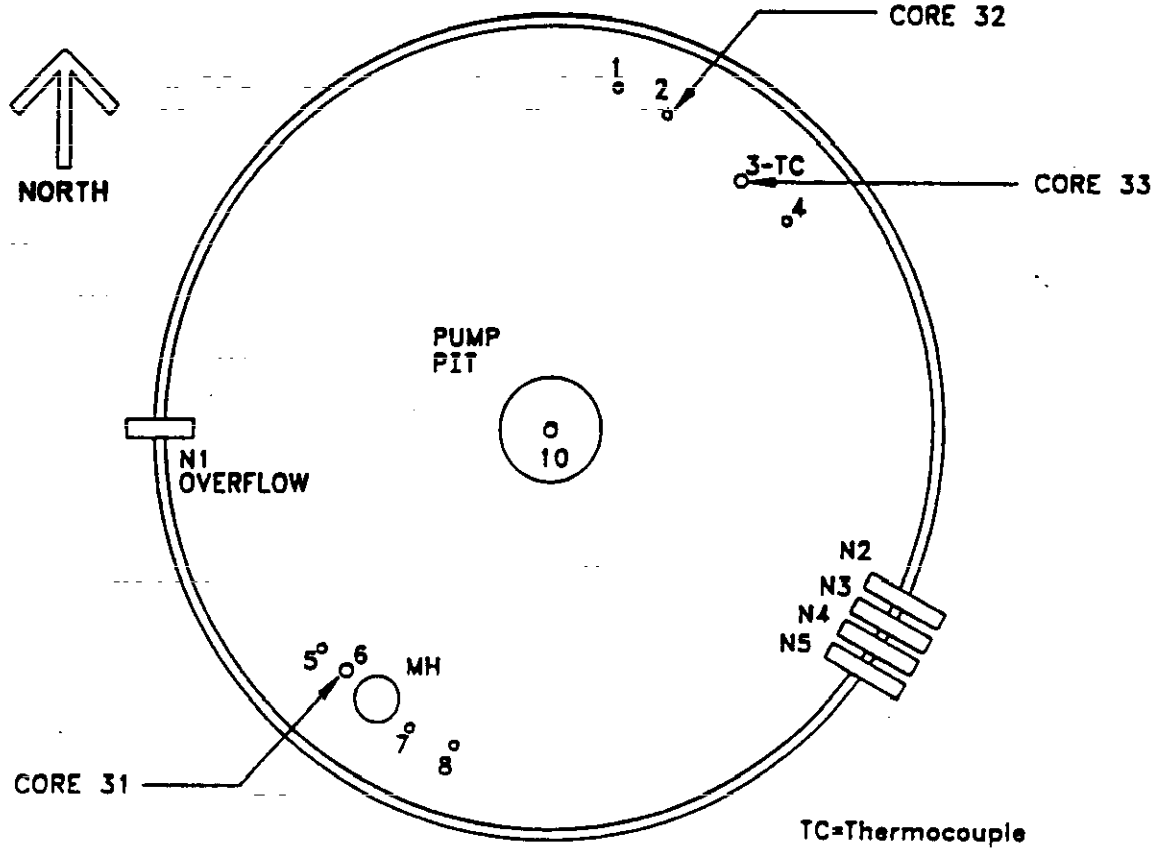
5.3 TANK 241-T-111 CORE SAMPLE RHEOLOGICAL/ PHYSICAL MEASUREMENTS

Physical and rheological assays consume substantial quantities of material. Tables 5-11 and 5-12 provide a breakdown of the total amount of sample available at the outset of the analylical effort. Figure 5-1 shows the location where the core samples were taken and the waste depth. Measurements of physical characteristics such as shear strength, viscosity, particle size, and settling properties were taken. These measurements are necessary for the design and fabrication of retrieval, pretreatment, and final waste disposal systems. Rheological assays were performed on samples from core 31, segments 2, 4, and 8. Particle size measurements were done on each segment of core 31. The data from segment 4 is not considered valid for these assays because it had dried before the measurements were taken. The drying process irreversibly changed the physical properties of the sample under investigation, and thus the sample is not considered representative. Therefore, the results from most of these assays will not be presented. However, in some cases it is useful to compare and contrast the results from the "representative" samples with the samples that dried.

Table 5-11. Tank 241-T-111 Core Sample Description Summary.

Core number	Segment number	Solid sample mass (g)	Liquid sample mass (g)	Approximate solid sample volume (mL)	Liquid sample volume (mL)	Approximate solid sample length
31	1	18.74	45.26	Not Recorded	~50	Not Resolved
31	2	178.68	4.12	150	NA	15 in. (38 cm)
31	3	162.2	NA	177	NA	18 in. (46 cm)
31	4	153.47	NA	148	NA	15 in. (38 cm)
31	5	190.94	NA	187	NA	19 in. (48 cm)
31	6	0	NA	0	NA	No Sample
31	7	186.44	NA	177	NA	18 in. (46 cm)
31	8	186.44	NA	187	NA	19 in. (48 cm)
31	9	203.08	NA	187	NA	19 in. (48 cm)

Figure 5-1. Current Condition of Tank 241-T-111.



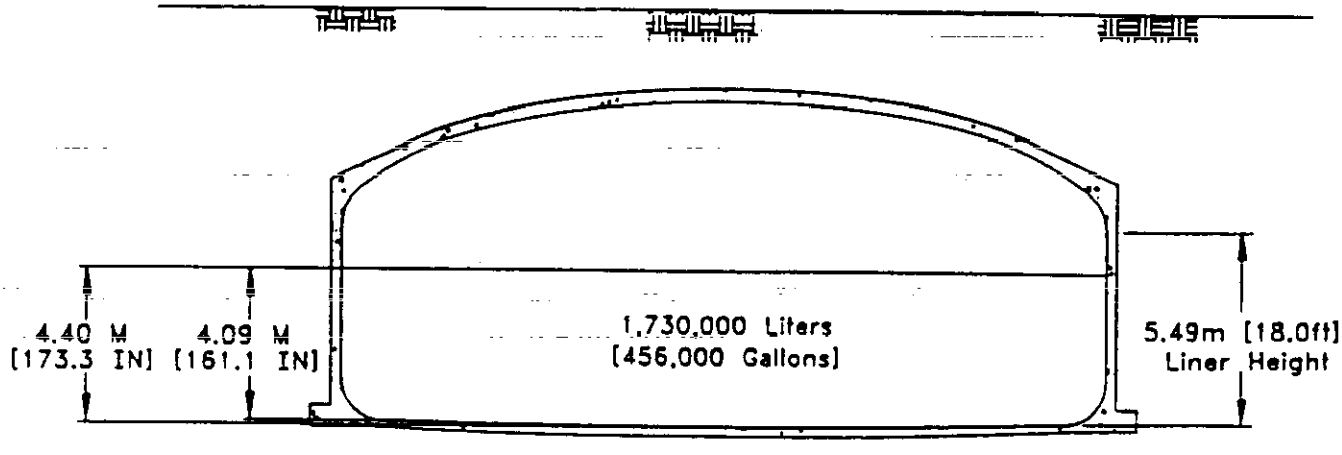


Table 5-12. Tank 241-T-111 Core Sample Description Summary.

Core number	Segment number	Solid sample mass (g)	Liquid sample mass (g)	Approximate solid sample volume (mL)	Liquid sample volume (mL)	Approximate solid sample length
33	1	159.16	0	137	NA	14 in. (36 cm)
33	2	209.59	0	187	NA	19 in. (48 cm)
33	3	167.9	0	163	NA	16 in. (41 cm)
33	4	182.05	0	167	NA	16 in. (41 cm)
33	5	174.3	0	167	NA	17 in. (43 cm)
33	6	217.37	0	187	NA	19 in. (48 cm)
33	7	196.91	0	187	NA	19 in. (48 cm)
33	8	199.8	0	187	NA	19 in. (48 cm)
33	9	191.01	0	187	NA	19 in. (48 cm)

5.3.1 Shear Strength

The shear strength of the waste from tank 241-T-111 was measured on the unhomogenized segment samples from core 31 (segments 2, 4, and 8). The shear strength measurements were made at ambient temperatures using a shear vane connected to a viscometer and rotated at 0.3 rpm. Shear strength (τ_s) is a semiquantitative measurement of the force required to move the sample. Because shear strength is dependent on sample handling, the measurement was taken without any sample homogenization. Small aliquots from the segments 2, 4, and 8 from core 31 were taken and assayed. The aliquots were transferred to a sample jar and allowed to settle for several weeks so that they could recover from the disturbance of sampling and extrusion. The extended delay between sample and analysis was permitted because it is believed that the longer the sample sits undisturbed, the closer it will resemble its original condition; therefore, the shear measurement is likely to be more representative. The shear stress (S_τ) of the sample was recorded as a function of time and the shear strength was calculated using Equation 1.

$$\tau_s = \frac{[\%\tau/100] * S_\tau * 4.9E+05}{\frac{\pi * H_v * D_v^2}{2} + \frac{\pi * D_v^3}{6}} \qquad (1)$$

where:

$\%\tau/100$	=	The ratio of the total torque to the maximum torque of the viscometer head, measured as a percentage of the full scale on the plot of the shear stress versus time diagram (dimensionless)
S_τ	=	Instrument reading proportional to the torque (dimensionless)
4.9E+05	=	maximum torque of the viscometer head (dyne•cm)
H_v	=	shear vane height (0.635 cm)
D_v	=	shear vane diameter (0.635 cm)

The shear strength for segments 2 and 8 were found to range 5,000 ± 2,300 dynes/cm^2. Segment 4 is not reported because of sample drying. Although relatively low, the shear stress of the material exceeded the baseline value for the measurement system (200 dynes/cm^2). Therefore, the values are considered to be valid and representative. Some additional drying of the sample may have occurred during the settling time, causing the shear stress to be higher than expected.

5.3.2 Shear Stress and Viscosity as Functions of Shear Rate

Shear stress measurements, as functions of shear rate, were performed on the as-received, 1 to 1 and 3 to 1 water to sample dilution of the sample at ambient hot-cell temperatures [ranging from 27 to 34 °C (81 to 93 °F)] and at 95 °C (203 °F). Drying the as-received sample at 95 °C posed difficulties in measurement; therefore no results of the rheograms for the samples run under those conditions are presented. In addition, the results from segment 4 are not presented because the drying that occurred compromised the sample properties, as discussed previously.

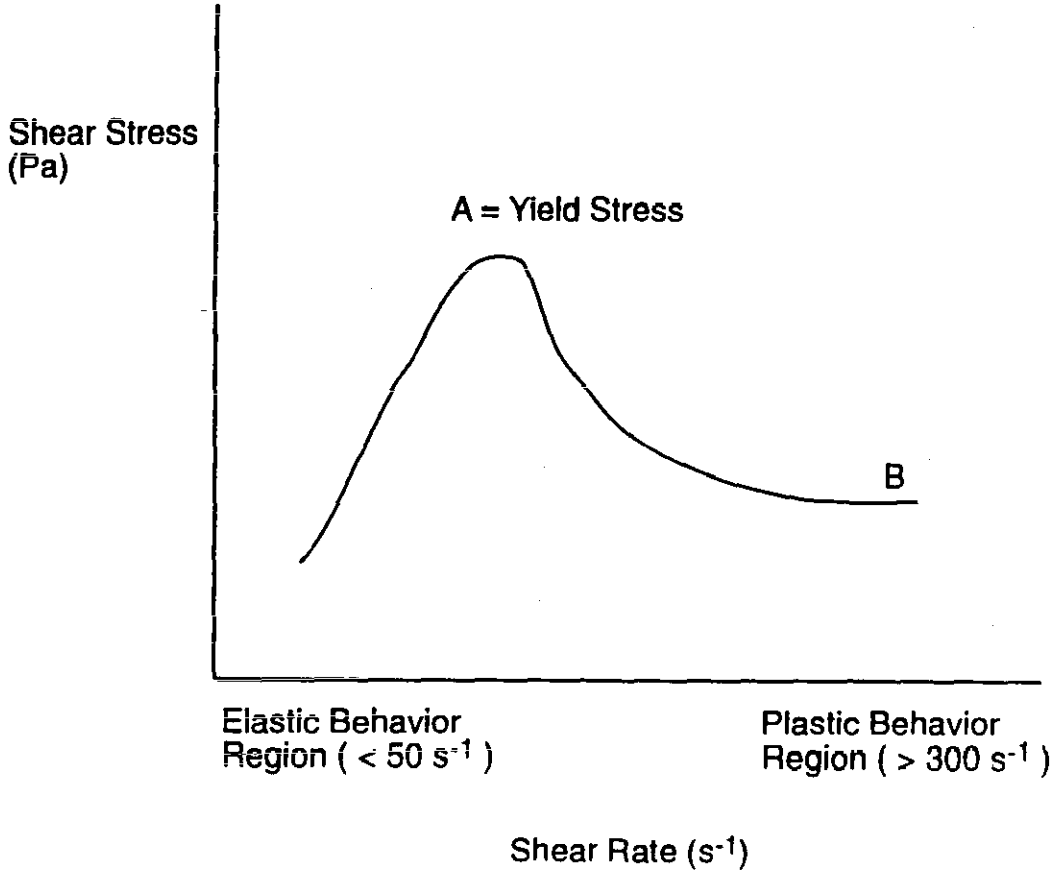
A rheogram for a material with a yield stress has two sections. The first section is a straight line beginning at the origin and climbing up the ordinate. This portion of the rheogram records the material as it acts like a solid or gel. When sufficient force is applied to the material to make it yield, the rheogram breaks sharply to the right; recording the material's behavior as a fluid. The point on the rheogram at which the sample's behavior transfers from a solid or gel to a fluid is the yield point or yield stress. This minimum shear stress must be exceeded to initiate fluid behavior. The tank wastes demonstrate both elastic and plastic behavior, depending on the amount of shear acting on them. The samples are elastic under low shear conditions (less than 50 s^{-1}), and plastic under high shear conditions (greater than 300 s^{-1}).

Viscosity measurements as a function of shear rate for the 1 to 1 diluted samples had viscosities near the limits of detection of the system (2 cP) for over the broad range of shear

rates; however, some qualitative and quantitative information was obtained from the measurement trials. Even though the measurements were at the limits of detection, the qualitative and quantitative behavior was consistent and reproducible. Viscosity was observed to increase slightly, then decrease with increasing shear rates. The 1 to 1 dilution of the segment 2 and segment 8 samples exhibited tendencies toward yield-pseudoplastic behavior. In fact, the general behavior exhibited by the wastes is best described by a yield-pseudoplastic model, however the system was not modeled and empirical model parameters were not determined because the system was at the detection limits. No other measurements of the viscosity as a function of shear rate were made on the 1 to 1 dilution samples at 95 °C (203 °F) or the 3 to 1 dilution samples.

Figures 5-2 to 5-6 are general illustrations of the rheograms. They are not to scale and do not fully capture all of the nuances and detail that is contained in each measurement trial. However, when coupled with the description underneath each diagram, much insight can be obtained about the flow properties of the waste. If more detailed rheological information is required, the data package should be consulted. Note that in the figures, Point A is where the sample begins to register movement. Point B represents the behavior of the sample at the maximum shear rate of the viscometer.

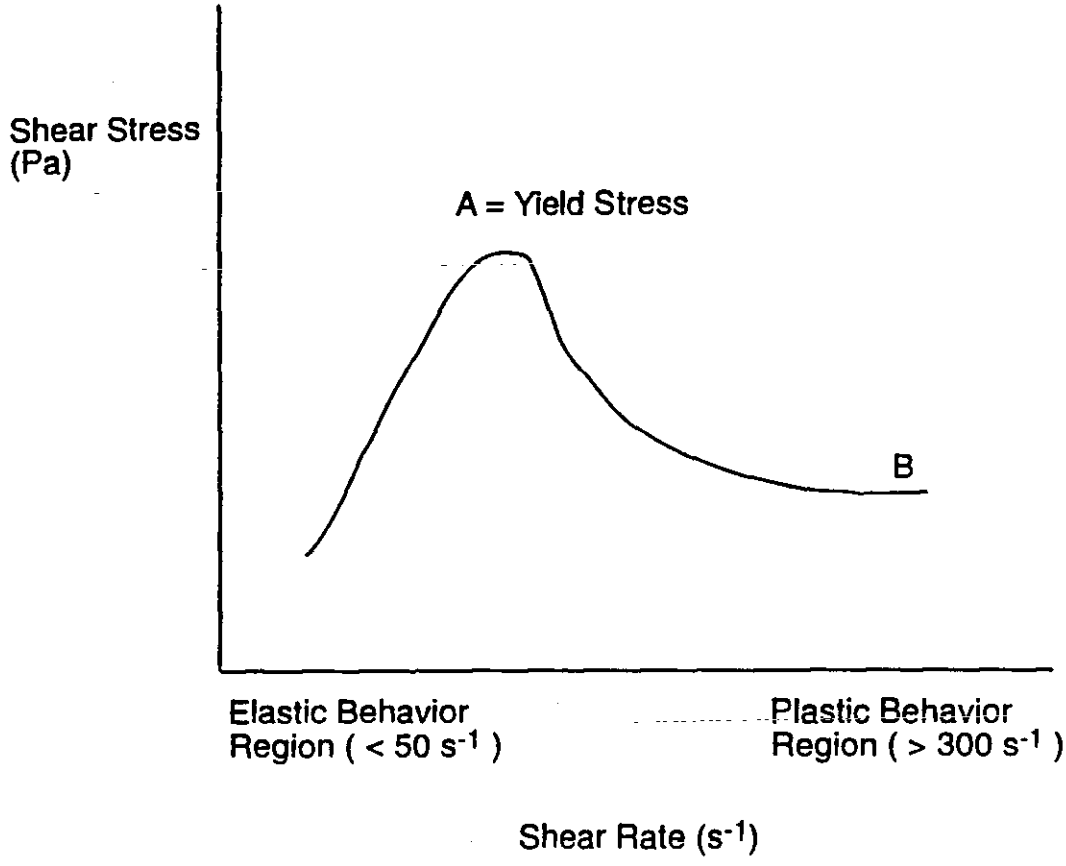
Figure 5-2. Shear Stress as a Function of Shear Rate: Direct Sample.



Shear Stress as a Function of Shear Rate: Direct Sample.

Sample: core 31	Sample number	Temperature (°C)	Point A shear stress range (Pa)	Qualitative behavior of rheogram	Point B shear stress (Pa)
Segment 2	80701	34	88 - 220	Wide variation at low shear, converging to a single value at high shear.	165
Segment 2	80703	33	200 - 680	Same	70
Segment 8	123201	33	36 - 108	Same	77
Segment 8	123202	33	0 - 108	Same	50

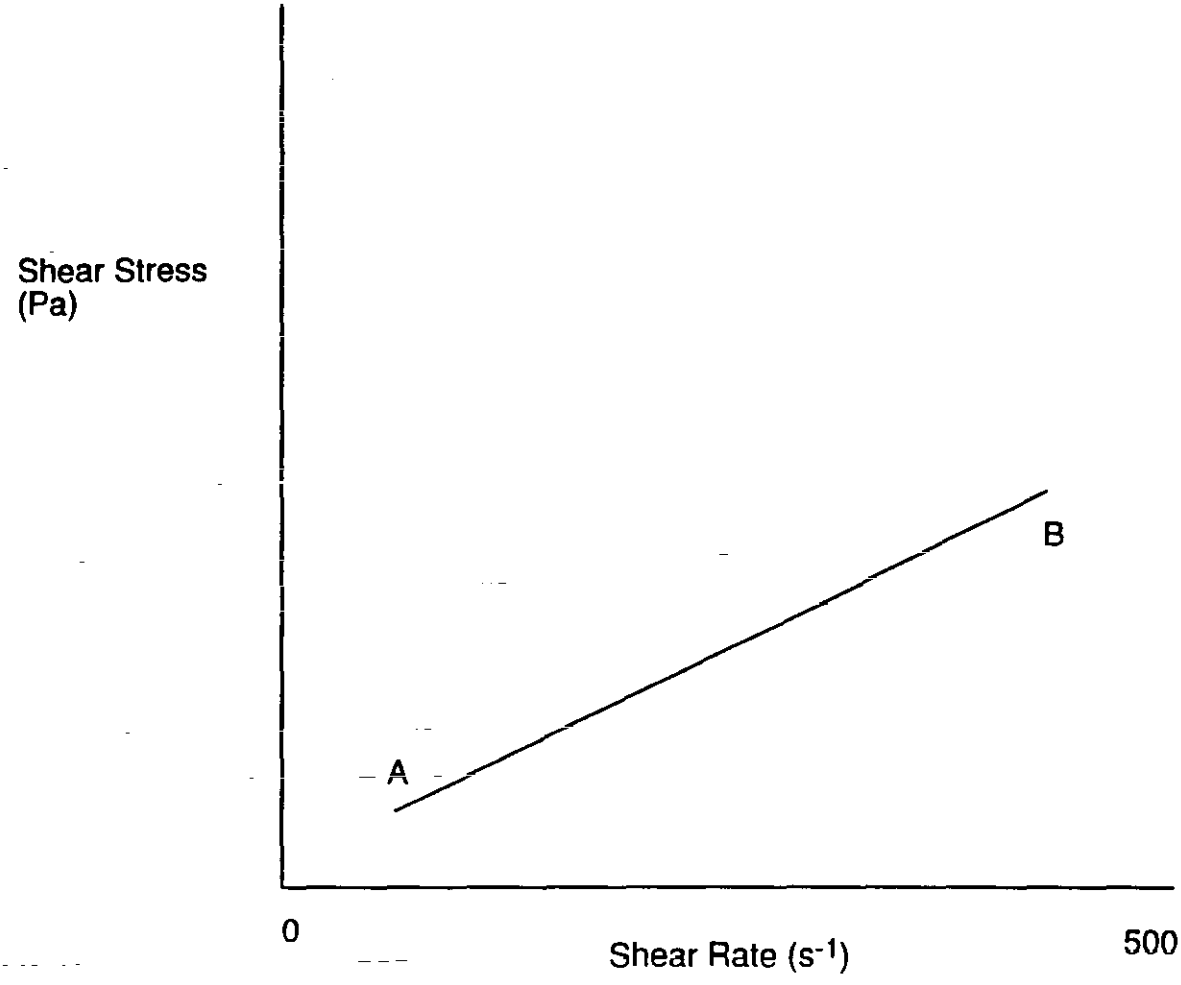
Figure 5-3. Shear Stress as a Function of Shear Rate: 1 to 1 Dilution, Water to Sample.



Shear Stress as a Function of Shear Rate: 1 to 1 Dilution, Water to Sample.

Sample: core 31	Sample number	Temperature (°C)	Point A shear stress range (Pa)	Qualitative behavior of rheogram	Point B shear stress (Pa)
Segment 2	1	27	0.6 - 4.2	Wide variation at low shear, converging to a single value at high shear.	2.4
Segment 2	2	27	1.2	Linear	2.8
Segment 2	3	95	1.0 - 7.0	Wide variation at low shear, converging to a single value at high shear.	2.0
Segment 2	4	95	0.7 - 1.1	Linear	1.2 - 1.4
Segment 2	5	95	1.0 - 2.4	Linear	2.2

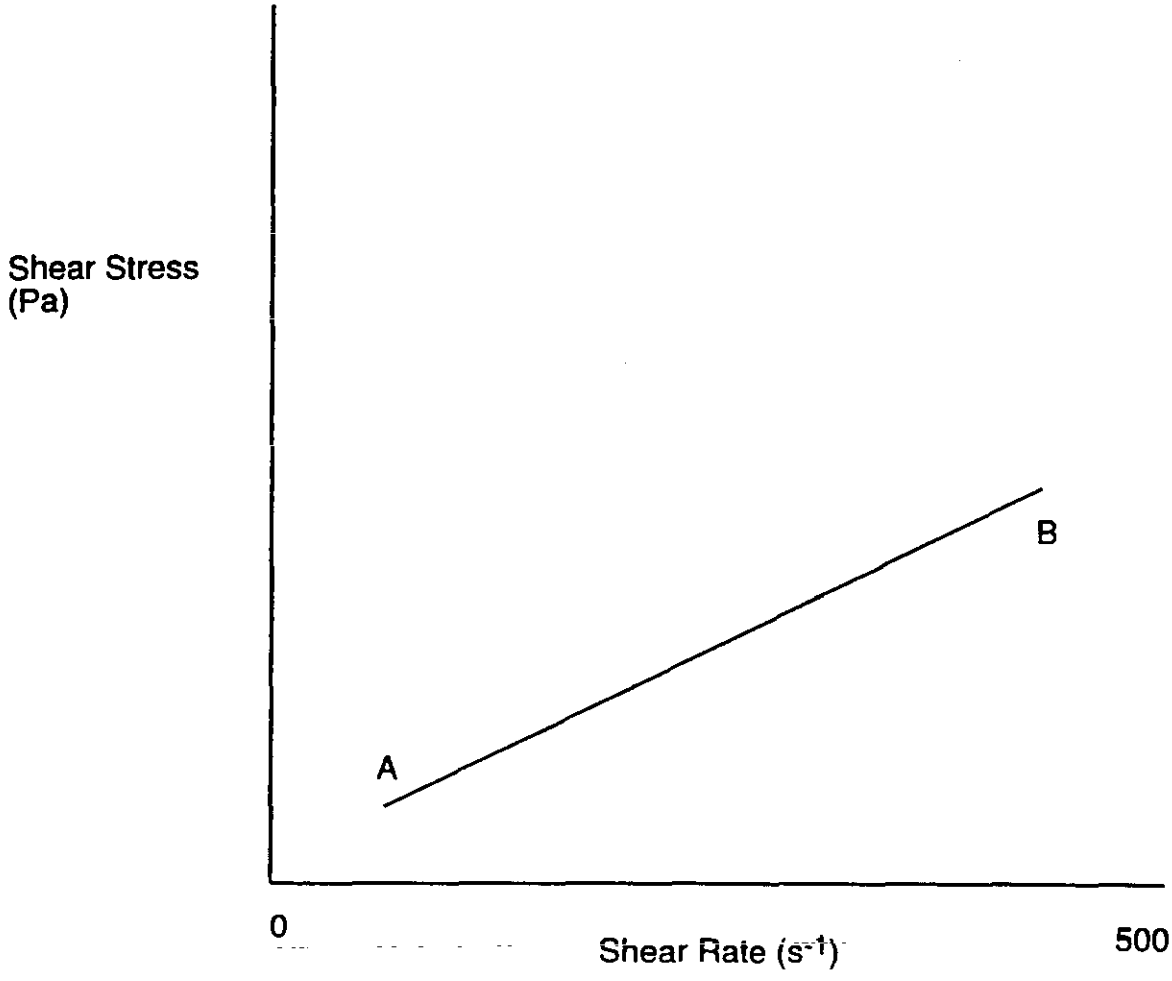
Figure 5-4. Shear Stress as a Function of Shear Rate: 1 to 1 Dilution, Water to Sample.



Shear Stress as a Function of Shear Rate: 1 to 1 Dilution, Water to Sample

Sample: core 31	Sample number	Temperature (°C)	Point A shear stress range (Pa)	Qualitative behavior of rheogram	Point B shear stress (Pa)
Segment 8	1	27	0.4 - 0.6	Linear	2.8
Segment 8	2	27	0.6	Linear	2.8
Segment 8	3	95	0.6	Linear	2.0
Segment 8	4	95	2.0 - 5.0	Erratic, non-linear	2.0
Segment 8	5	95	0.2	Linear	0.7 - 0.9

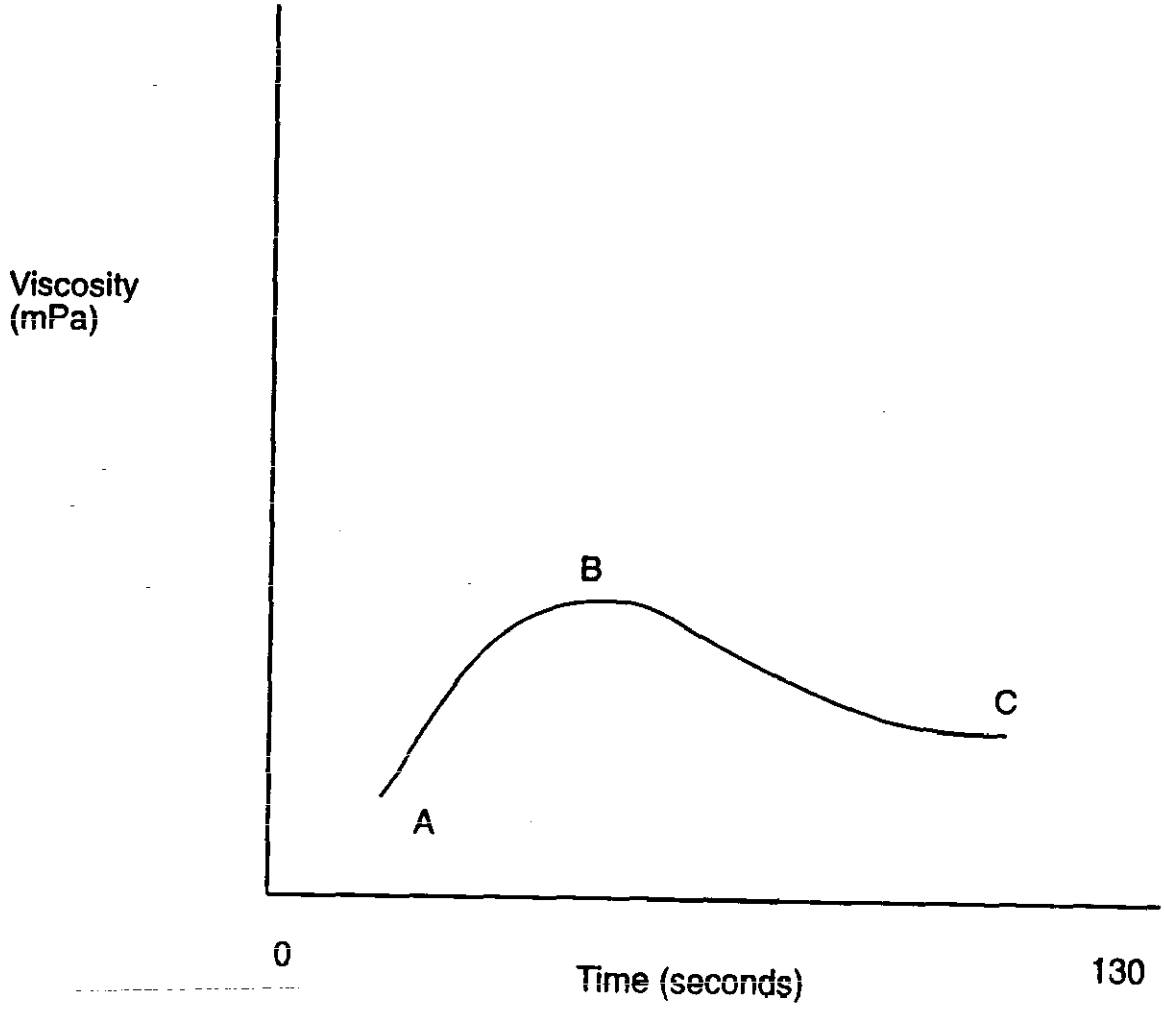
Figure 5-5. Shear Stress as a Function of Shear Rate: 3 to 1 Dilution, Water to Sample.



Shear Stress as a Function of Shear Rate: 3 to 1 Dilution, Water to Sample.

Sample: core 31	Sample number	Temperature (°C)	Point A shear stress range (Pa)	Qualitative behavior of rheogram	Point B shear stress (Pa)
Segment 2	1	27	0.05 - 0.25	Linear	0.75 - 1.1
Segment 2	2	27	0.2 - 0.35	Linear	1.2
Segment 2	3	95	0.2	Linear	0.8
Segment 2	4	95	0.3	Linear	1.0
Segment 8	3	95	Not defined	Erratic, non-linear	0.4
Segment 8	4	95	0.3	Linear	1.0

Figure 5-6. Viscosity as a Function of Time: 1 to 1 Dilution, Water to Sample.



Viscosity as a Function of Shear Rate: 1 to 1 Dilution, Water to Sample

Sample: core 31	Sample number	Temperature (°C)	Point A viscosity (mPa)	Qualitative description of rheogram	Point B viscosity (mPa)	Point C viscosity (mPa)
Segment 2	1	30	0.65	Rises, levels off, then gradually declines	1.8 - 2.0	1.5 - 1.7
Segment 2	2	30	0.56	Slightly sinusoidal	0.6	0.6
Segment 2	3	30	0.80	Rises, levels off, then gradually declines	1.0	0.9
Segment 8	3	30	0.75	Flattened exponential growth and decay curve	1.0	0.75
Segment 8	4	30	0.85	Flattened exponential growth and decay curve	0.95	0.9

5.3.3 Particle Size Measurement

Particle size is analyzed by placing a small amount of sample in a dispersant, which is the liquid used to disperse and suspend the particles from the solid sample. Samples from each segment of core 31 were prepared and assayed. The prepared sample was placed in a particle size analyzer. The apparatus measures particle size by passing a thin beam of laser light through the dispersant. The diameter of a particle in the dispersant can be determined by the amount of light that it blocks as it passes through the beam. The dimension measured by this method is the value across the short diameter of the particle. This means that if a particle is oblong, the machine estimates the shortest length across the particle. The term "diameter" throughout this text will be used to describe any linear profile of any shape.

An important consideration involving the analysis of particle size is the dispersant used. The primary concern involved with the dispersant is that it may dissolve the particle. Any particles existing in the tank that are soluble in the dispersant will dissolve or decrease in size during the analysis. Depending on the dispersant, the particle size analysis may not represent the true particle size distribution in the tank. In the case of tank 241-T-111, water was used as the dispersing medium. If a true particle size distribution is required, the mother liquor, or drainable liquid of the tank should be used if possible because the tank particulates are already in equilibrium with the tank's mother liquor. The insolubility of the waste matrix suggests that the particle size data acquired should be acceptable.

The mean particle size in the number distribution runs in a narrow range from 0.93 to 1.23 microns in diameter for tank 241-T-111 waste samples. Table 5-13 presents the summary results of the measurements.

Table 5-13. Core 31 Particle Size Distribution by Number.

Segment	Mean (μm)	Standard deviation	Median (μm)
1	1.23	0.89	0.94
2	1.13	0.80	0.88
3	1.17	1.00	0.91
4	0.93	0.60	0.80
5	0.95	0.63	0.81
6	-	-	-
7	0.97	0.60	0.83
8	1.02	0.85	0.82
9	1.02	0.83	0.83

Table 5-14 presents the summary results of the volume distribution measurements. Assuming that the density of the solid material within the tank is constant, the volume distribution is also the best estimation of the mass particle size distribution of the tank.

Table 5-14. Core 31 Particle Size Distribution by Volume.

Segment	Mean (μm)	Standard deviation	Median (μm)
1	28.56	35.92	5.81
2	14.91	20.76	4.79
3	64.99	46.19	58.69
4	24.87	34.15	5.63
5	37.87	47.91	12.31
6	-	-	-
7	7.95	11.88	4.02
8	24.72	28.18	10.02
9	59.69	49.04	58.97

The number density graph is plotted over the acquisition range of the device (from 0.5 to 150 microns). The numbers of particles in each size range, shown as a percentage of the whole, are graphed against their respective size ranges to form a distribution curve. The figures show that the modes for particle size range between the origin and 2.0 microns. In

fact, over 80 percent of the measured particles fit within this narrow band. As with the number distribution, the volume distribution is represented by a probability volume density graph. The average particle size in the volume distribution is considerably larger than in the number distribution. The particle size in the volume distribution ranges over the full scale of the device, 0.0 microns to 150 microns in diameter, between the eight segments (core 31 segment 6 was empty, but the nomenclature for the other samples held). The analyzer calculates particle volume as the cube of the diameter.

In core 31, approximately 70 percent of particle measurements for segments 1, 2, 4, 5, 7, and 8 fall into the range between 0.0 and 24.0 microns, and tend to be dispersed towards the smaller particle sizes. Segments 3 and 9 were exceptions to this rule. They had a distribution over the broad spectrum of particle sizes, with the particles generally much larger and more widely scattered over the 0.0 to 150.0 micron range and a slight tendency towards the smaller end of the scale. In segment 3, 23 percent of the particles were less than 24 microns. In segment 9, 40 percent of the particles were less than 24 microns.

The disparity between the segment measurements possibly indicates a difference in waste type, or perhaps a transitional layer between two waste types that individually are physically similar, but when commingled, may precipitate larger particulate materials. In segments 1, 2, 4, 5, 7, and 8, over 60 percent of the particles in the sample have a diameter of less than 24.0 microns. In segments 3 and 9, over 50 percent of the particles have a diameter of greater than 24.0 microns. In the retrieval and subsequent treatment of the tank wastes, it may be desirable to design pumping or filtration systems for the tank particulate. Therefore, the volume distribution of the particles should not be neglected (i.e., particles with diameters of over 20 microns should be considered in these designs). In addition, variation in particle size distribution is believed to have an impact on analytical precision, especially with small sample sizes, and thus, should be considered when evaluating analytical results. Plots of the probability number and volume density for each core are presented as Figures 5-7a to 5-14b.

5.3.4 Settling Behavior of As-Received and Diluted Samples

This section analyzes the settling behavior and physical properties of the grab samples and the as-received 1 to 1 and 3 to 1 water to sample dilutions. The physical properties reported here include settling rates and volume percent for settled solids and weight percent and volume percent for centrifuged solids. The experimental procedures used to take these measurements were reported previously (McKinney et. al 1993). The physical properties of the grab samples are reported in Table 5-15. The properties for core 31 samples are summarized in Table 5-16.

Figure 5-7a. Core 31, Segment 1, Particle Size: Number Density.

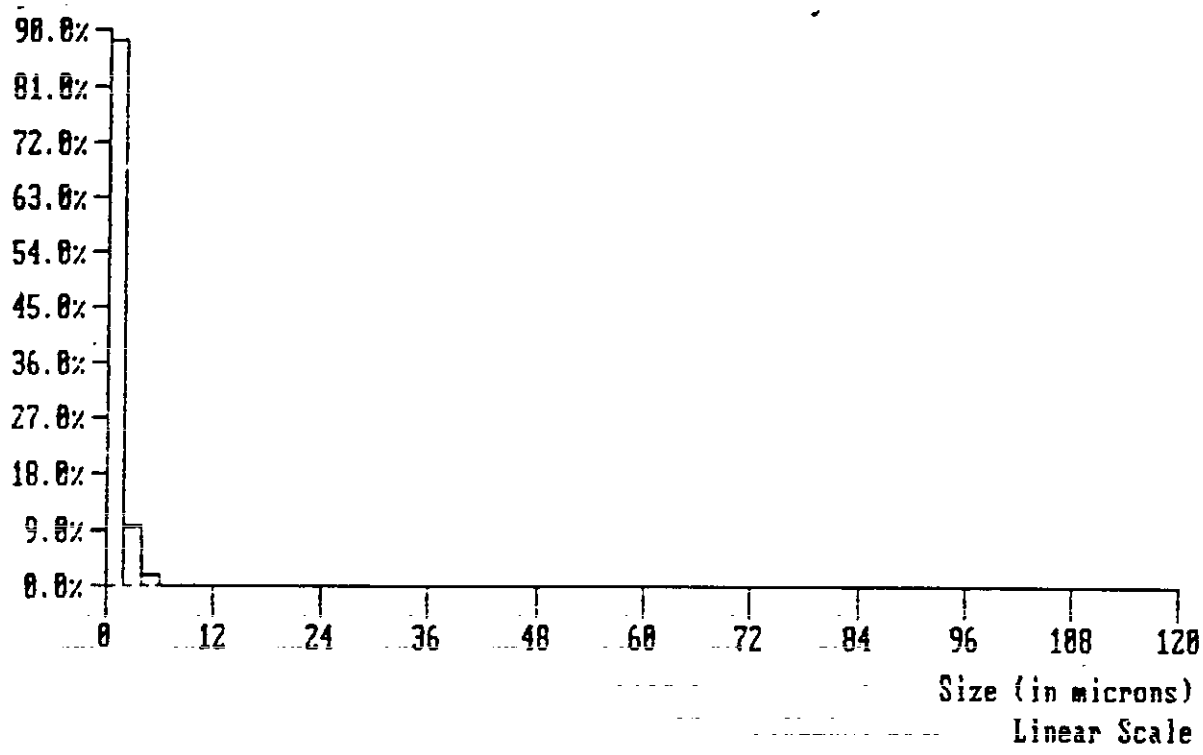


Figure 5-7b. Core 31, Segment 1, Particle Size: Volume Density.

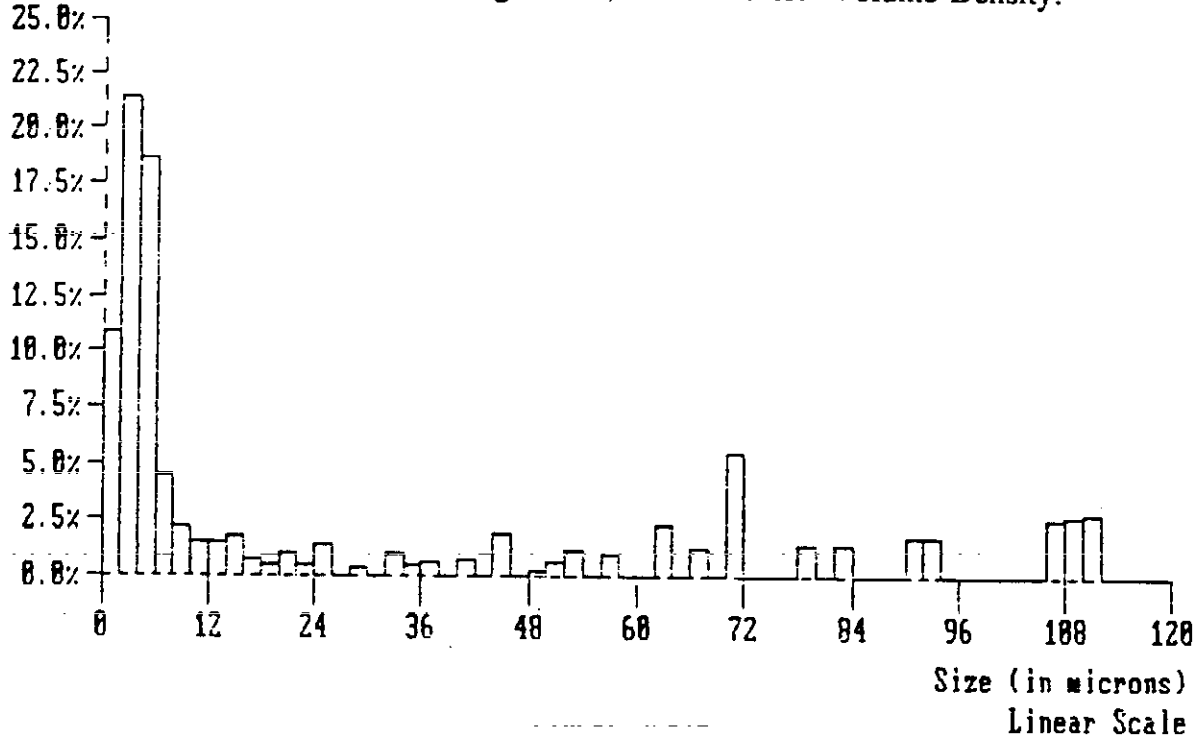


Figure 5-8a. Core 31, Segment 2, Particle Size: Number Density.

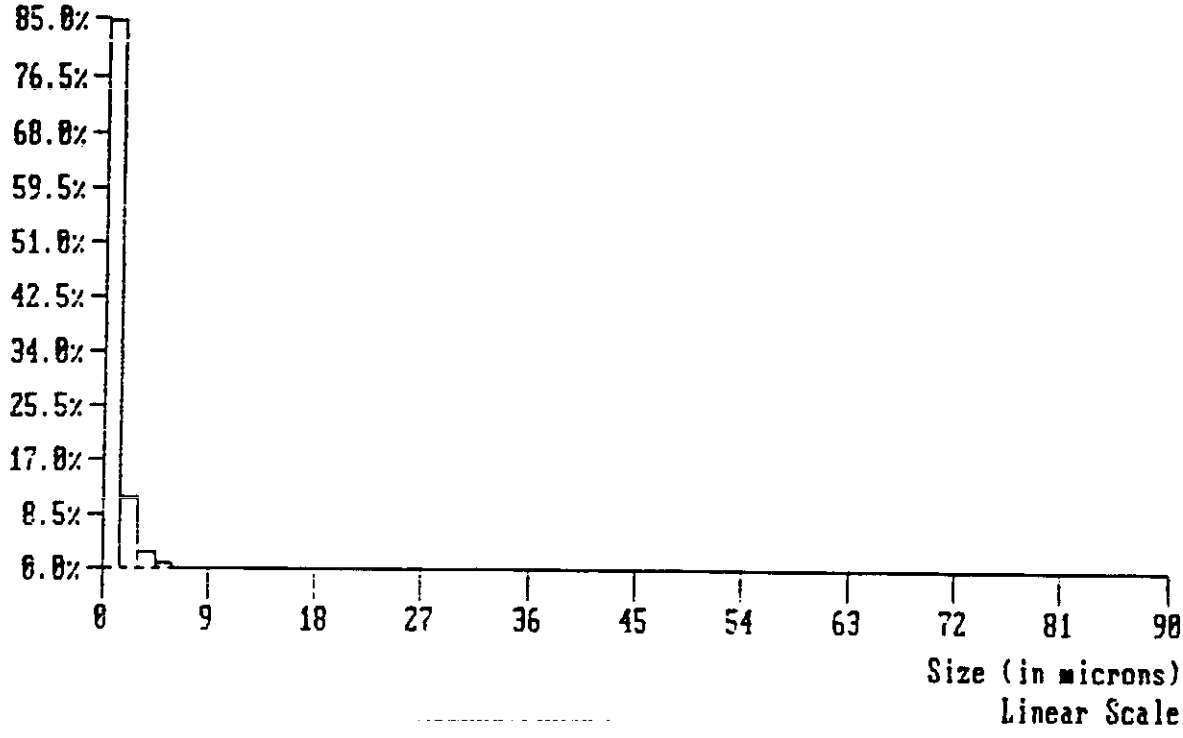


Figure 5-8b. Core 31, Segment 2, Particle Size: Volume Density.

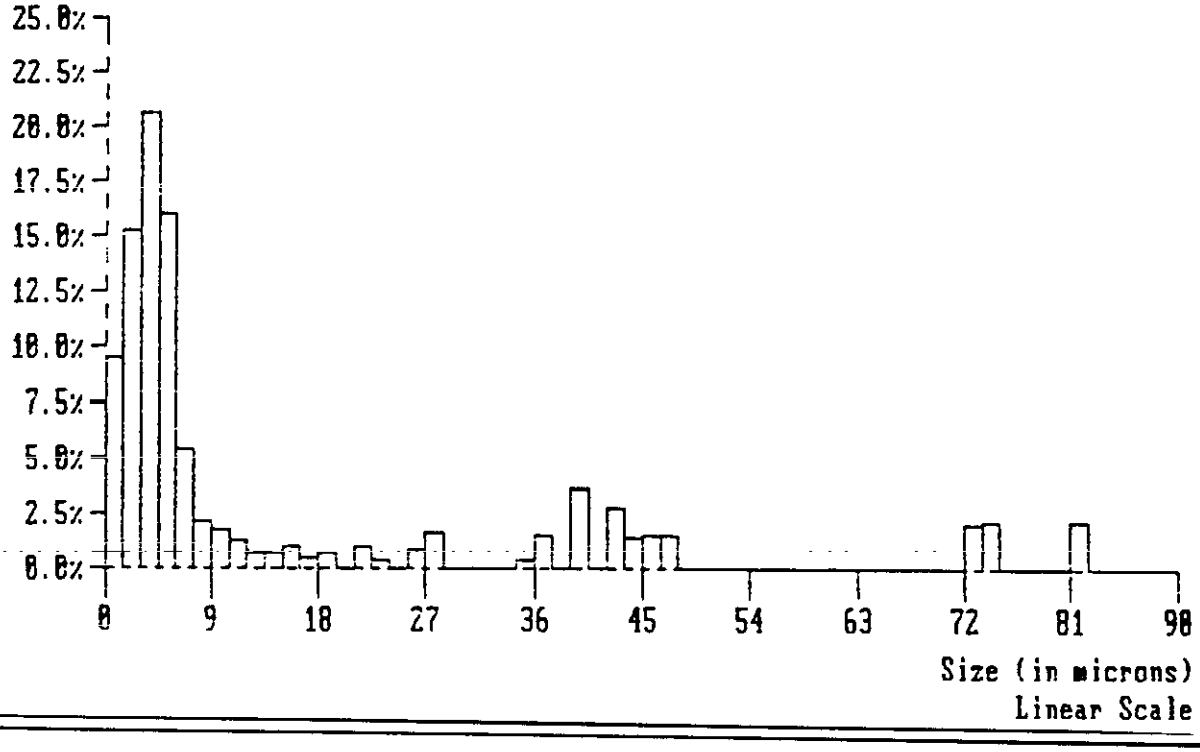


Figure 5-9a. Core 31, Segment 3, Particle Size: Number Density.

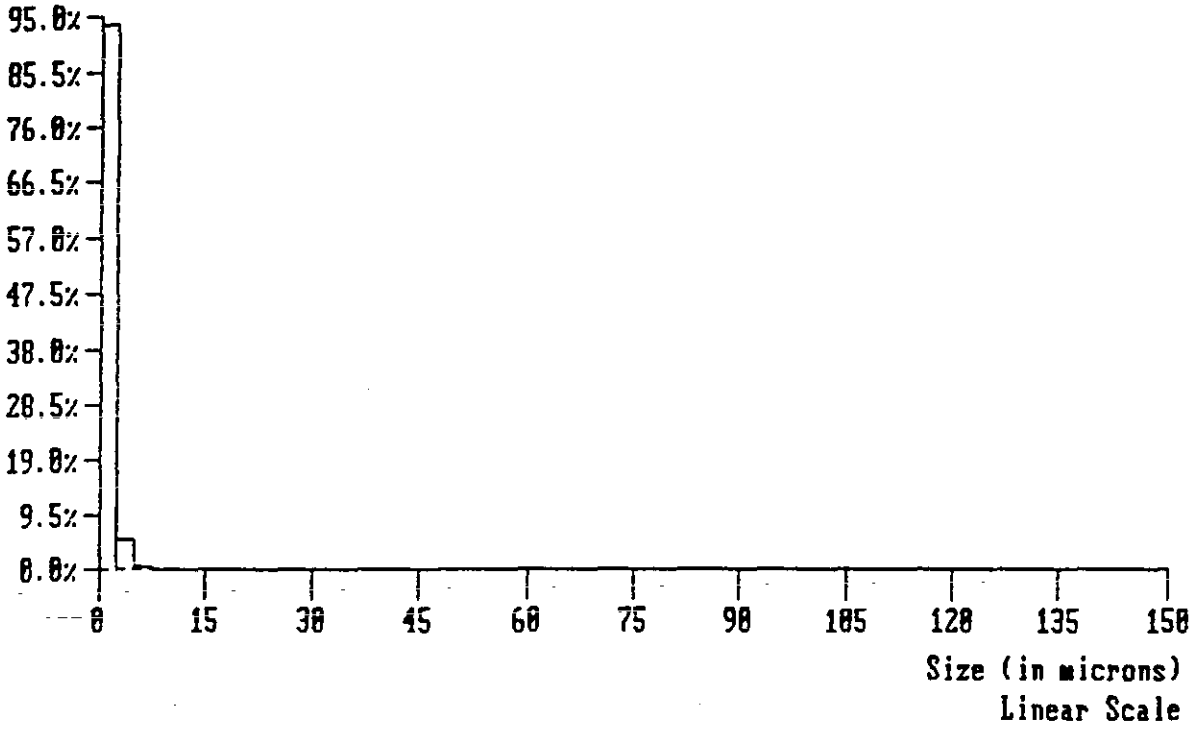


Figure 5-9b. Core 31, Segment 3, Particle Size: Volume Density.

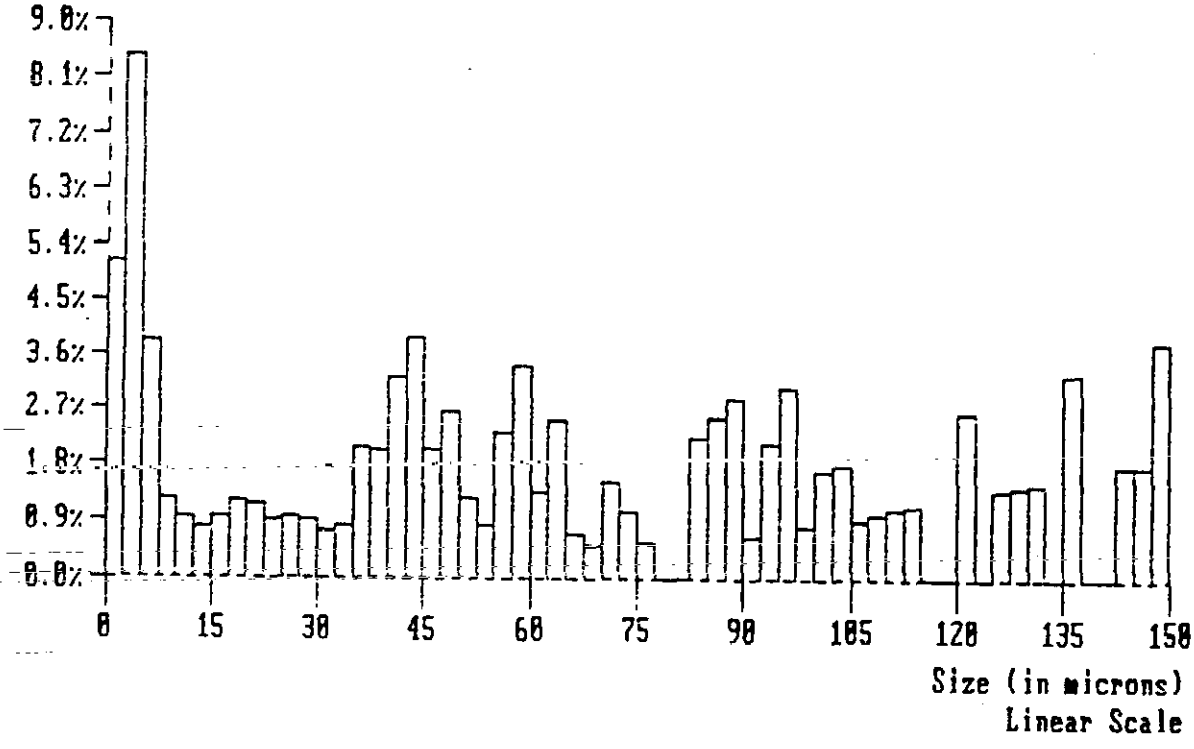


Figure 5-10a. Core 31, Segment 4, Particle Size: Number Density.

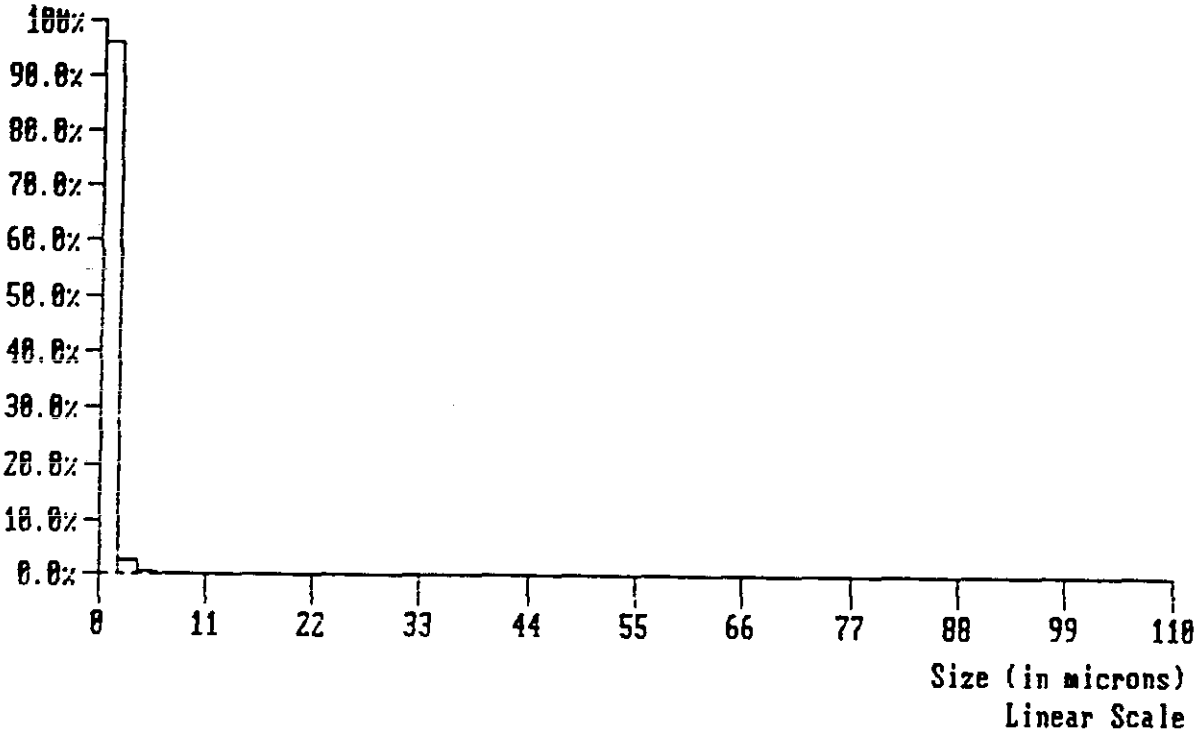


Figure 5-10b. Core 31, Segment 4, Particle Size: Volume Density.

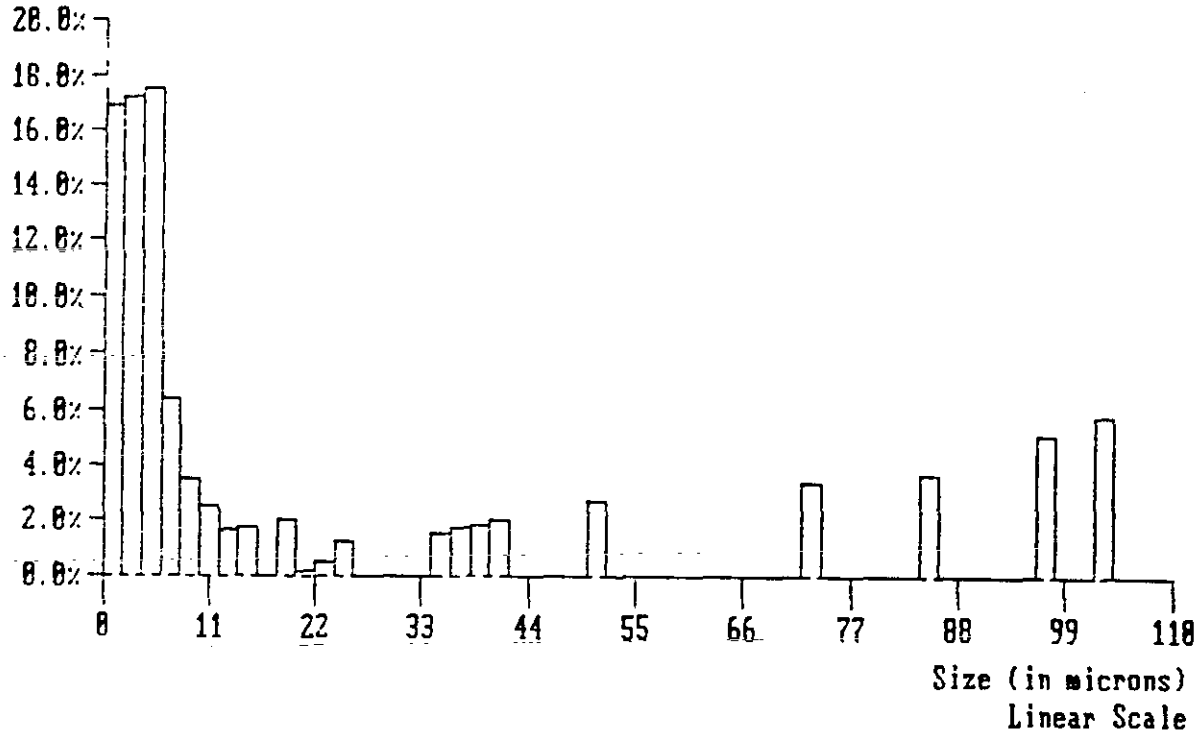


Figure 5-11a. Core 31, Segment 5, Particle Size: Number Density.

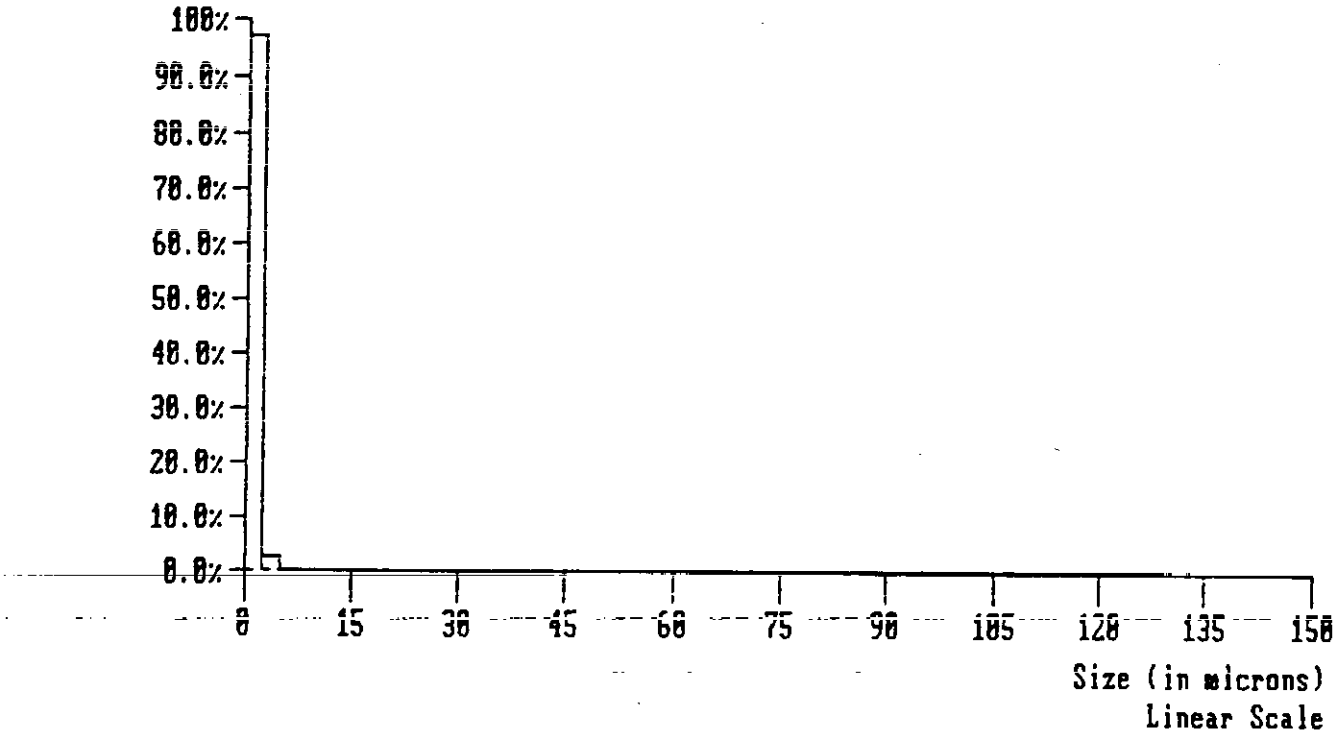


Figure 5-11b. Core 31, Segment 5, Particle Size: Volume Density.

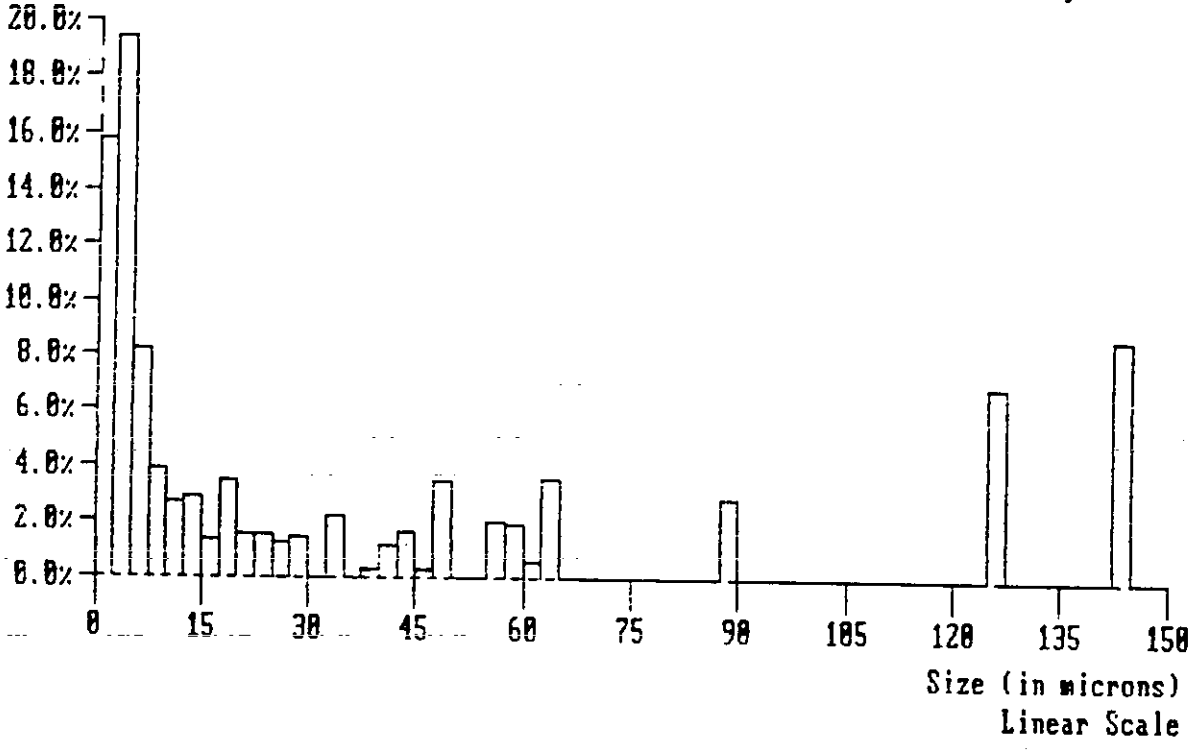


Figure 5-12a. Core 31, Segment 7, Particle Size: Number Density.

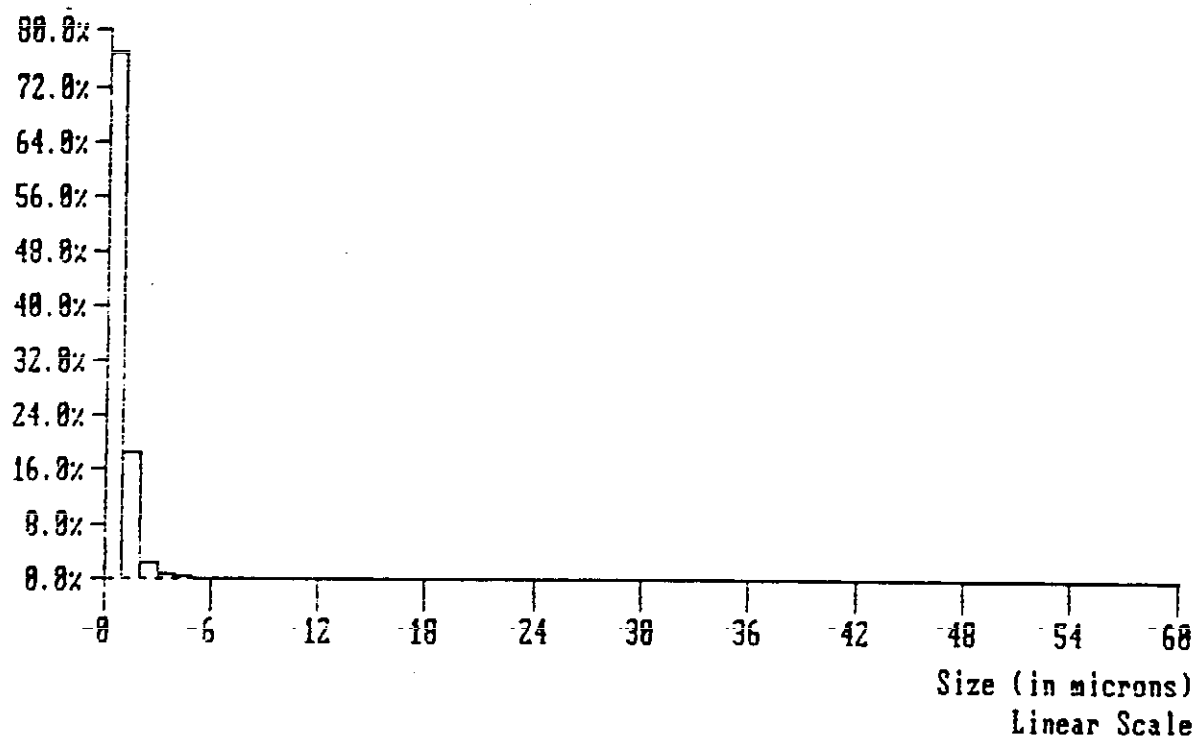


Figure 5-12b. Core 31, Segment 7, Particle Size: Volume Density.

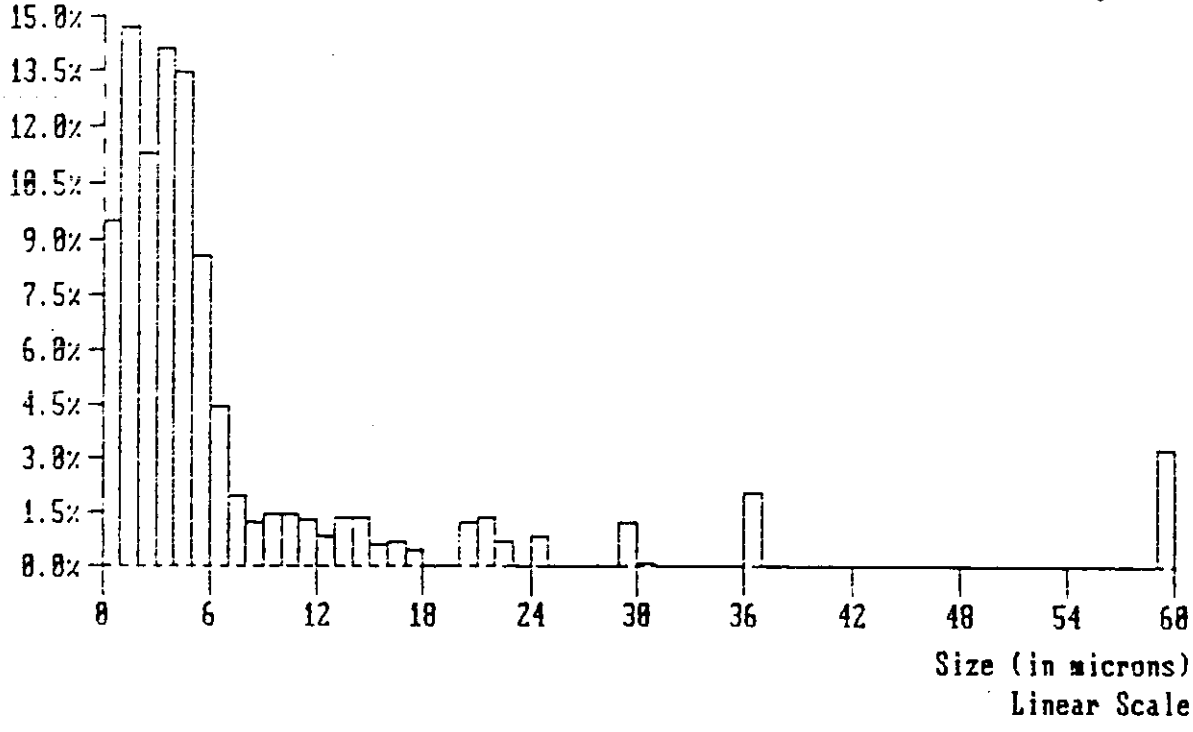


Figure 5-13a. Core 31, Segment 8, Particle Size: Number Density.

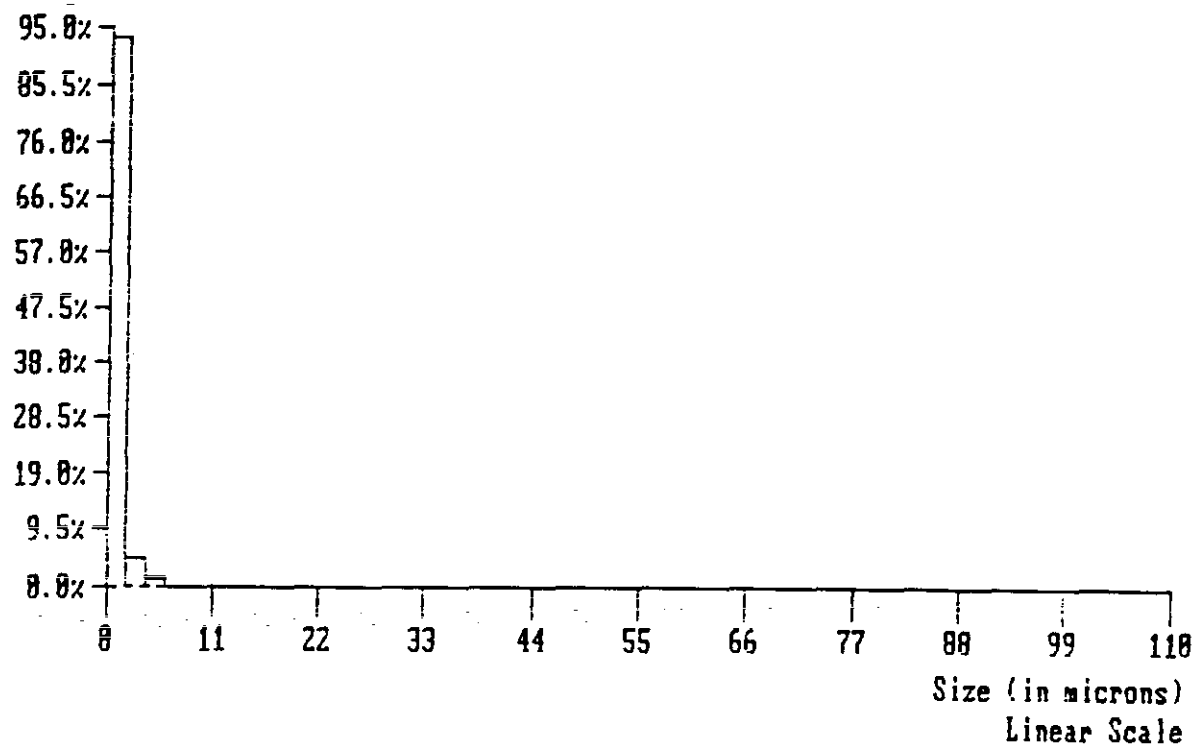


Figure 5-13b. Core 31, Segment 8, Particle Size: Volume Density.

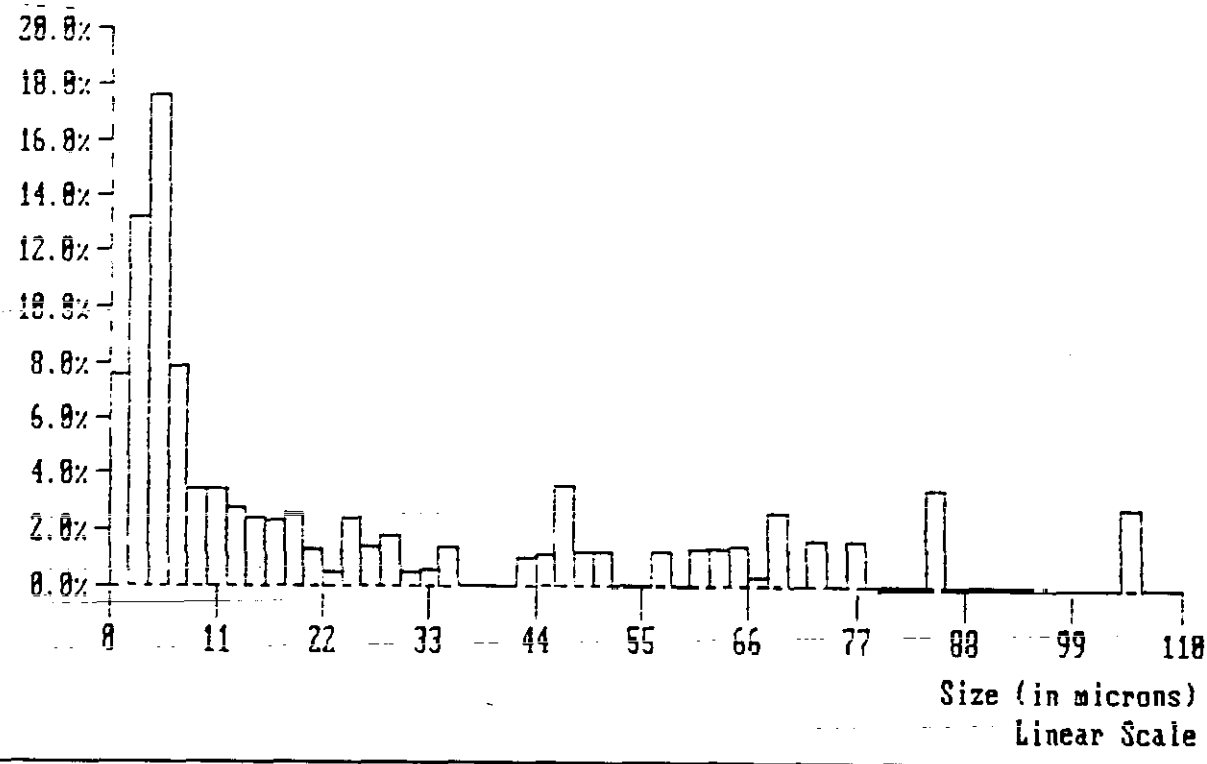


Figure 5-14a. Core 31, Segment 9, Particle Size: Number Density.

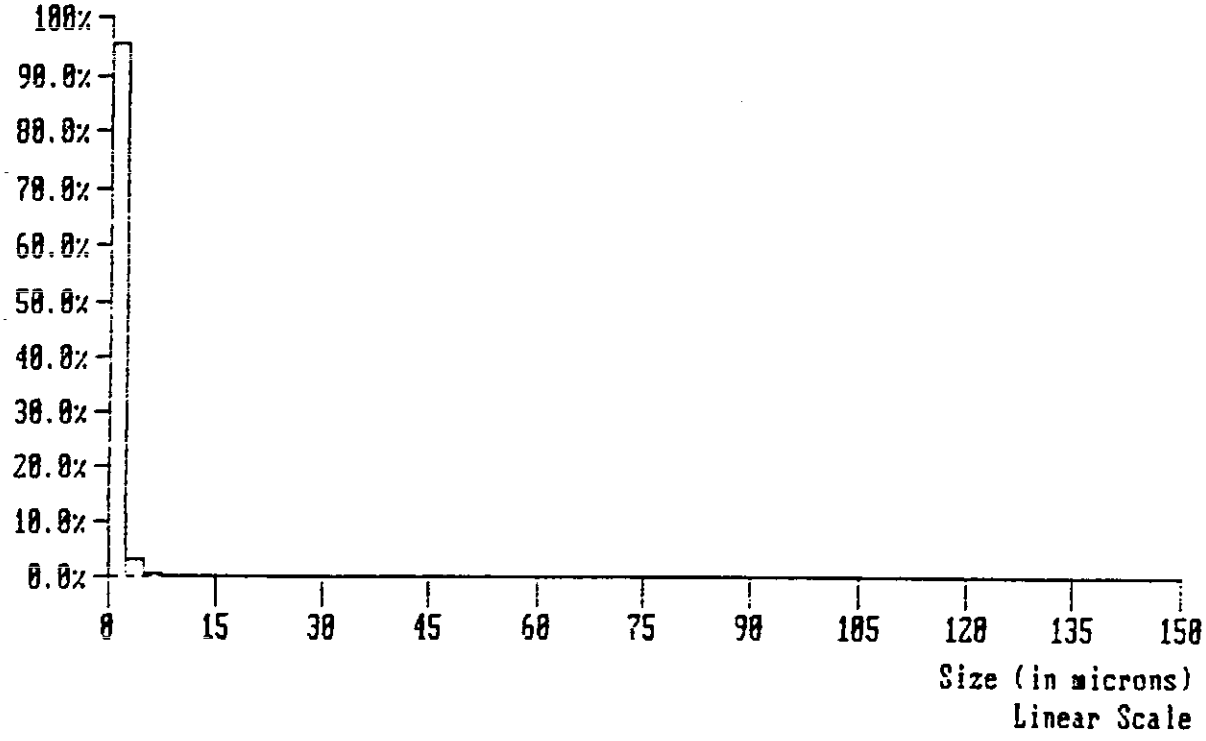


Figure 5-14b. Core 31, Segment 9, Particle Size: Volume Density.

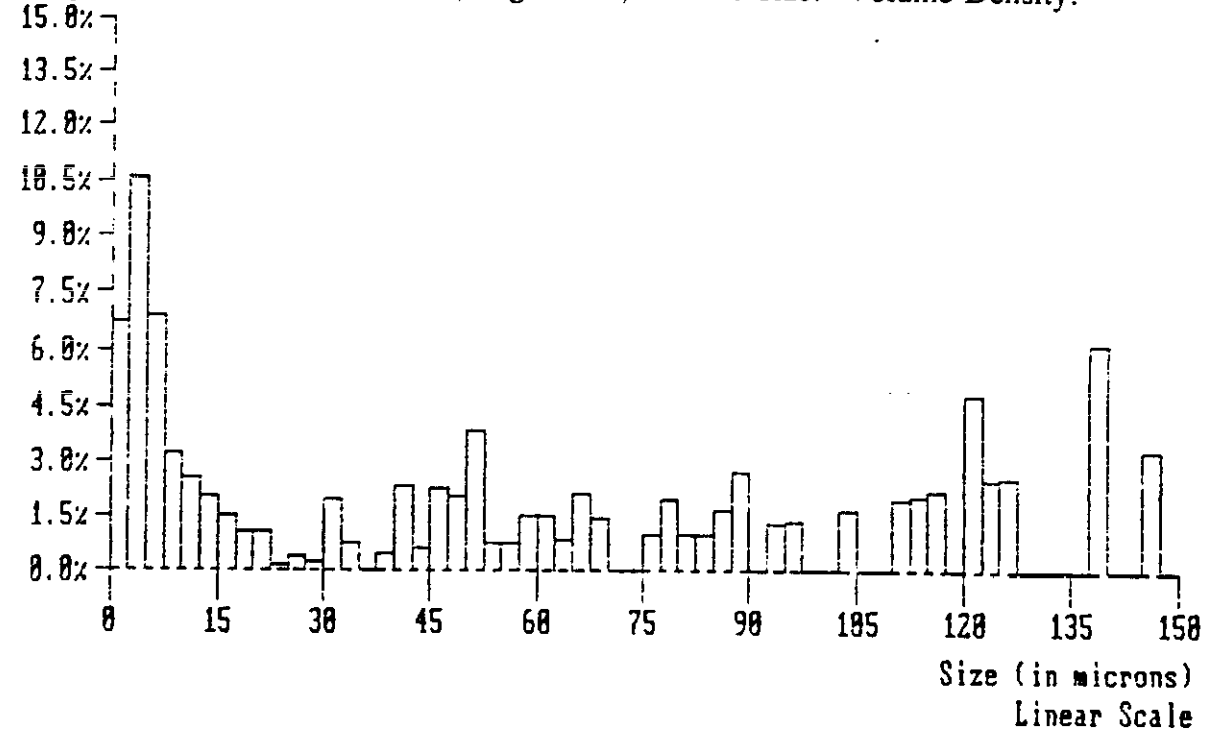


Table 5-15. Grab Sample Physical Properties Summary.

Property	Grab sample #1	Grab sample #2	Grab sample #3	Average value
Specific gravity	1.036	1.038	1.033	1.036
pH	11.57	11.59	11.78	11.65
Wt% H_2O	92.70	92.90	92.90	92.83
Wt% H_2O (TGA)	91.17	91.73	90.24	91.05
Settled solids (vol%)	< 1%	< 1%	< 1%	< 1%

The grab samples were clear yellow liquids with no particulate.

Table 5-16. Physical Properties Summary.

Property		Sample	
		Core 31, segment 2	Core 31, segment 8
Settled solids (vol%)	As-Received	100%	100%
Wt% Solids		22.4	29.3
Wt% Undissolved solids		19.0	25.4
Density (g/mL)		1.19	1.28
Centrifuged samples			
Vol%	1 hour at 1,000 gravities	65.8	71.9
Wt%		67.3	75.9
Centrifuged supernate density (g/mL)		1.07	1.10
Centrifuged solid density (g/mL)		1.22	1.34

No settling was observed in the as-received segment samples over a period of three days, and there was no standing liquid obtained from the samples. Two dilutions of 1 to 1 and 3 to 1 water to sample ratios, respectively were prepared, and the volume-percent settled solids for each of the dilutions are plotted as a function of settling time.

The 1 to 1 dilution for segment 2 reaches a final volume percent settled solids of 85 to 87 percent. Settling is observed throughout the three-day period, but the majority of the settling is observed in the first 10 hours. The 3 to 1 dilution reaches a final volume-percent settled solids of approximately 52 percent. Again, settling is observed over three days, and the first 10 hours is when the majority of the solids settle. Qualitatively, the settling behavior for both sample dilutions is a steep, nearly linear relationship between the initial

fluidization of the material and the first 10 hours of settling. After that, the final 10 percent of the suspended solids take up almost the rest of the time settling in a long, gradual decline, before coming to equilibrium.

The 1 to 1 and 3 to 1 dilutions for segment 4 were compromised by drying the sample before its assay. However, some observations and contrasts with the other samples are appropriate. Settling is mostly completed after 3 to 4 hours, and is complete after 10 hours. This is in sharp contrast to the other samples for which there is a long, asymptotic-like settling behavior observed for a substantial portion of the suspended solids (10 to 15 percent), after the initial settling phase. This behavior is suggestive of a colloid or gel for segments 2 and 8. In contrast, segment 4 appears to be a collection of discrete particles with no interaction between them.

The 1 to 1 dilution for segment 8 reaches a final volume-percent settled solids of about 80 percent (see Figure 5-17a). Settling is observed throughout the three-day period, but the majority of the settling is observed in the first 10 hours. The 3 to 1 dilution reaches a final volume-percent settled solids of approximately 40 percent. Again, settling is observed over three days and the first 10 hours is when the majority of the solids settle. Qualitatively, the settling behavior for both sample dilutions is a shallow, nearly linear relationship between the initial fluidization of the material and the first 10 hours of settling. The slope of this line is much more gradual than that of segment 2 for the corresponding dilutions. After the first 10 hours, the final 15 percent of the suspended solids take up almost the rest of the time settling in a long, gradual decline before coming to equilibrium. Table 5-17 summarizes the settling behavior for the samples investigated. Figures 5-15a through 5-17b illustrate the setting behavior over time.

Table 5-17. Settling Comparison for 1 to 1 and 3 to 1 dilutions for Core 31 Segments 2, 4, and 8.

Analyte	Segment 2		Segment 4		Segment 8	
Dilution: water to sample	1:1	3:1	1:1	3:1	1:1	3:1
Final volume % solids	87	52	22	22	80	40

5.4 ANALYTICAL RESULTS--ENERGETICS

TGA and DSC were performed on subsegment and core-composite material from tank 241-T-111. These two thermal analysis techniques are used to determine the thermal stability or reactivity of a material. In DSC analysis, heat flow over and above the usual heat capacity of the substance is measured while the substance is exposed to a linear increase in temperature, i.e., the change in temperature, divided by the time elapsed is constant (dT/dt = constant). While the substance is being heated, a cover gas (usually air or N_2) is passed over the waste material to remove any gases being released. The onset temperature

Figure 5-15a. Settling Rate Data for Tank 241-T-111 Core 31, Segment 2, 1 to 1 Dilution.

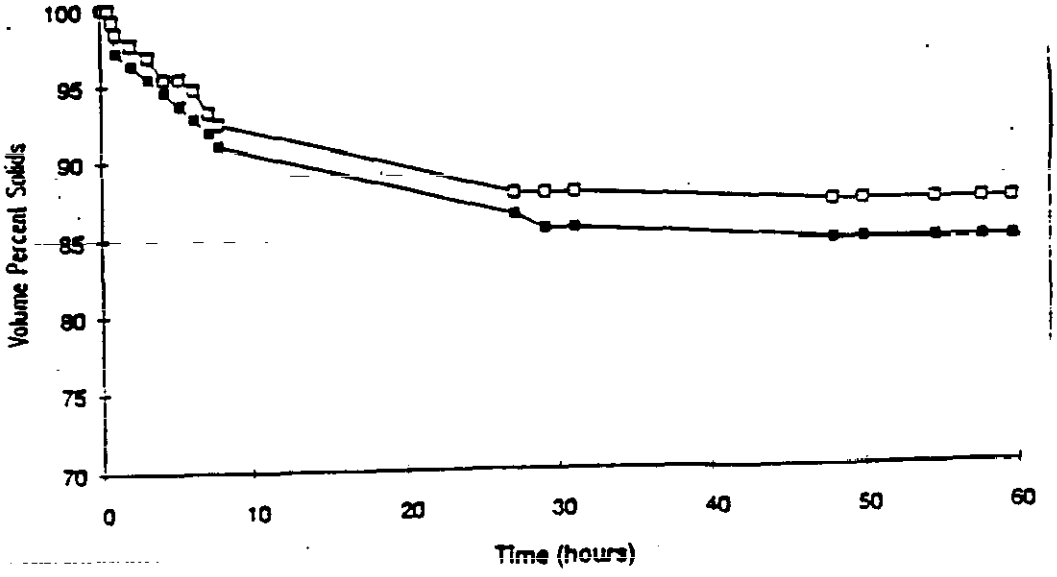


Figure 5-15b. Settling Rate Data for Tank 241-T-111 Core 31, Segment 2, 3 to 1 Dilution.

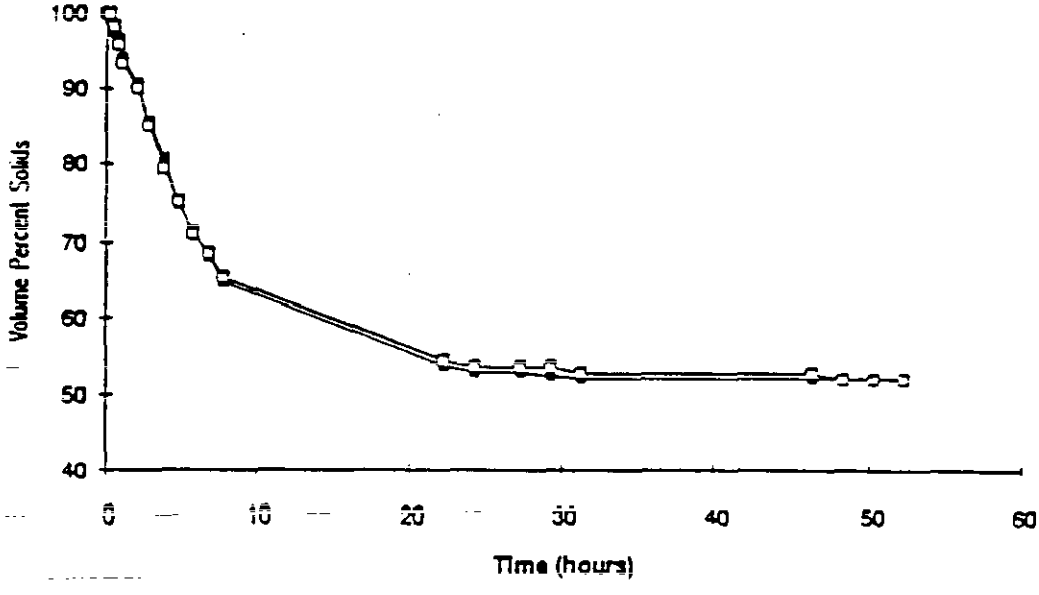


Figure 5-16a. Settling Rate Data for Tank 241-T-111 Core 31, Segment 4, 1 to 1 Dilution.

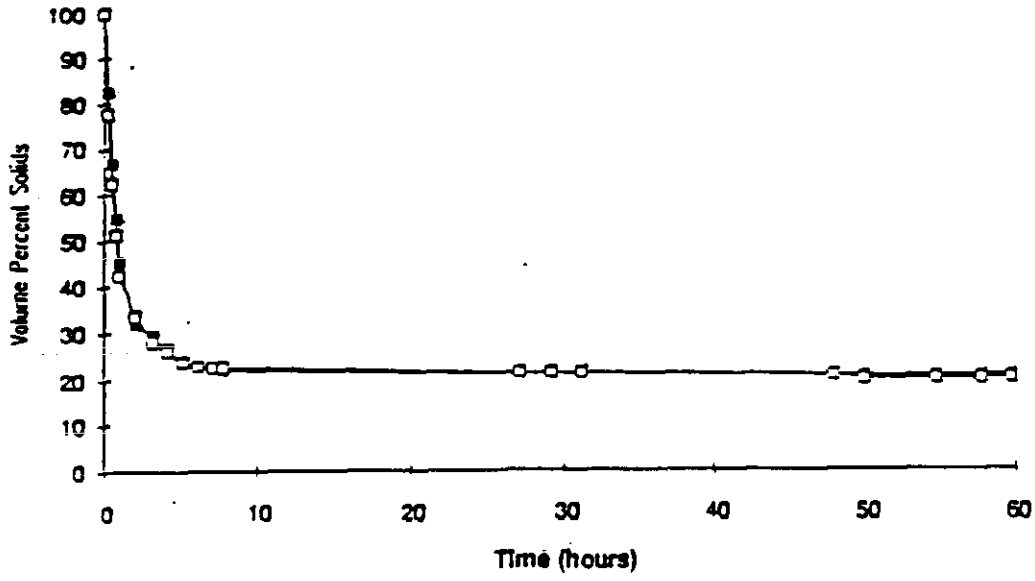


Figure 5-16b. Settling Rate Data for Tank 241-T-111 Core 31, Segment 4, 3 to 1 Dilution.

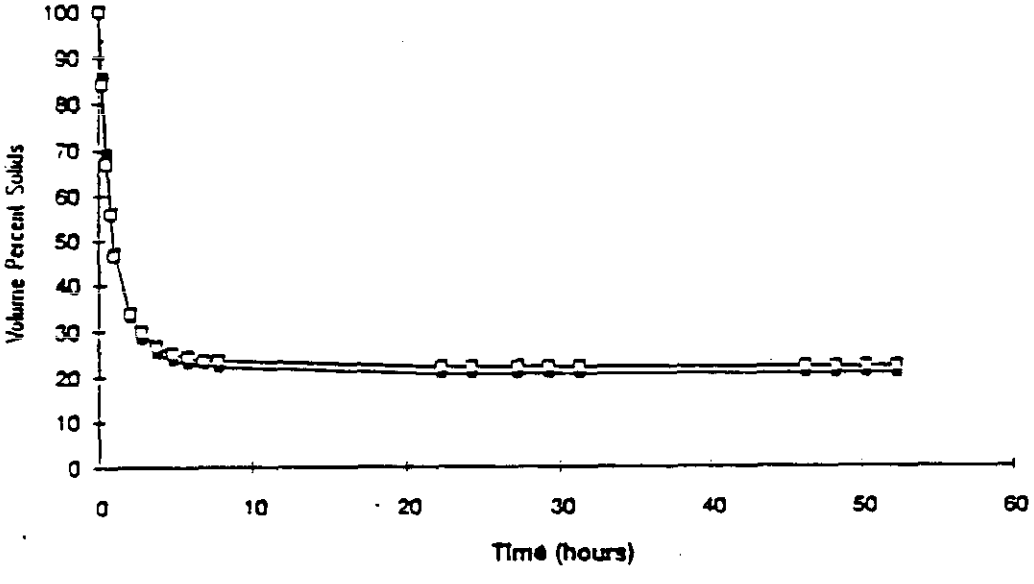


Figure 5-17a. Settling Rate Data for Tank 241-T-111 Core 31, Segment 8, 1 to 1 Dilution.

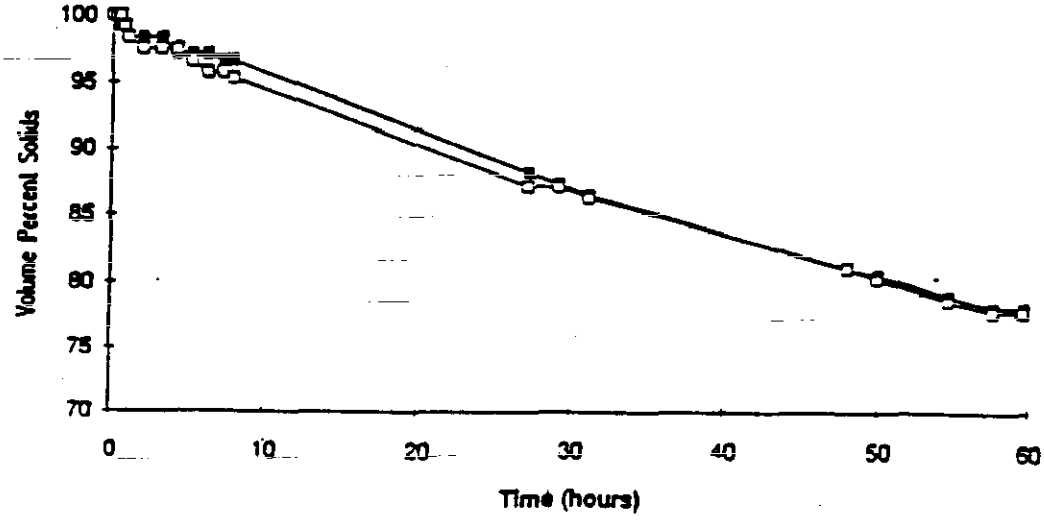
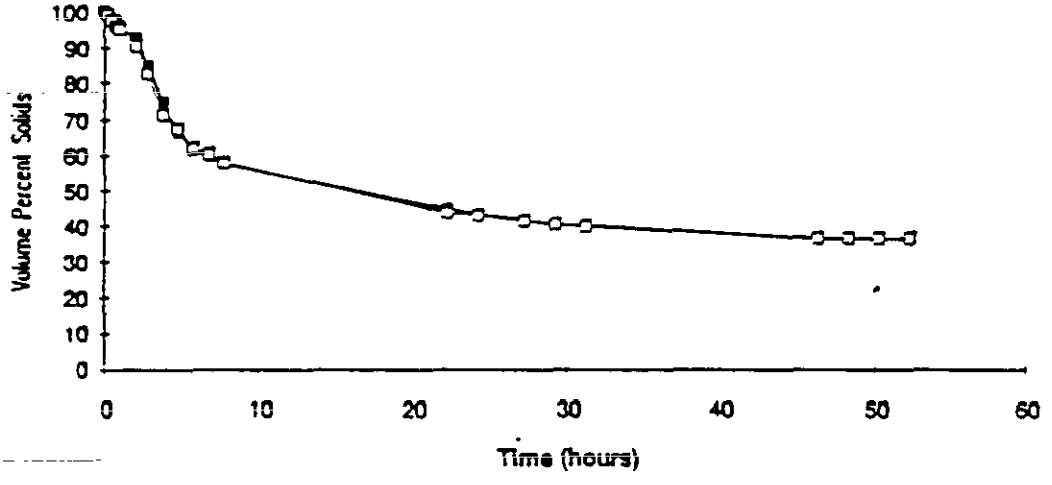


Figure 5-17b. Settling Rate Data for Tank 241-T-111 Core 31, Segment 8, 3 to 1 Dilution.



for an endothermic or exothermic event on a DSC is determined graphically. The endpoints of the event are determined and a line is drawn between them to establish a base. A line tangent to the initial side of the event is drawn until it intersects the base. From that point of intersection, a vertical line is constructed to the temperature scale at the bottom of the DSC curve. That temperature is the onset temperature of the event.

TGA measures the mass of a sample while the temperature of the sample is increased at a constant rate. The X-axis is representative of the running time of the analysis as well as the temperature increase of the sample during analysis. The Y-axis represents the weight percent of the sample and is effectively unitless. As with the DSC, a cover gas is passed over the sample during heating. Any decrease in the weight percent of the sample represents a loss of gaseous matter from the sample either through evaporation or a reaction that forms gas phase products.

DSC is often used to measure thermal decomposition temperatures, heats of reaction, reaction temperatures, melting points, and solid-solid transition temperatures. TGA is used to measure thermal decomposition temperatures, water content, and reaction temperatures. The two methods often provide complementary information.

5.4.1 Remarks on the Interpretation of Differential Scanning Calorimetry/Thermogravimetric Analysis Data

Tables 5-18, 5-19, and 5-20 summarize the results of the thermal analyses performed. Although DSC assays were performed on the grab samples, the results were uniformly negative (i.e. no exotherms were observed). Where exotherms were observed, there are two significant features seen on the DSC and one on the TGA plots. The endothermic DSC event overlaps the area where the substantial majority of the sample mass is lost as recorded by the TGA, suggesting that this endotherm is a result of the evaporation of water from the sample. The values presented in the tables may not exactly match the values derived from the DSC and TGA plots, especially exotherm magnitudes. This is because interpreting these semi-quantitative analyses requires considerable experience and judgement on the part of the analyst, and differences in perception and judgement between readers can be expected in a semi-quantitative analysis. Appendix A contains copies of all of the DSC and TGA traces and results.

Additional physical properties work was performed to expand the understanding of the exothermic behavior of some of the segments (WHC 1994, Delegard 1994). Table 5-21 presents additional energetics results for core 33, segments 1 and 2. These samples were dried under a vacuum at 60 °C before analysis, using either air or nitrogen as a cover gas. Even after drying, the samples retained 10 to 12 weight percent water. Table 5-22 presents a brief summary of the analytical results for the average sample properties as-received after centrifuging samples from core 31, segments 3 and 7, and core 33, segments 1 and 7, at 500 gravities for 113 hours.

5.4.2 General Comments on the Differential Scanning Calorimetry/ Thermogravimetric Analysis Behavior of the Samples

The first transition in each sample is endothermic, begins at the lower temperature limit of the analysis (30 °C), and essentially is complete between 140 and 180 °C. The most likely phenomenon occurring in this region is the release of the bulk and interstitial water in the core sample material. The endotherms exhibited in this region are substantial (typically in excess of 1,000 J/g). These values are per gram of wet sample. If divided by the mass fraction lost during analysis, they range from 1,600 to 1,900 J/g (dry) and correspond roughly with the heat of vaporization of water (2,260 J/g). The TGA water content corresponds reasonably well with the water loss observed in a gravimetric weight percent solids determination; however, the gravimetric weight percent water assay is consistently lower.

Table 5-18. Percent Water Analyses Results from Tank 241-T-111.

Sample I.D.	Core 31 average gravimetric Wt% loss	Core 31 average TGA transition 1 Wt% loss	Core 33 average gravimetric Wt% loss	Core 33 average TGA transition 1 Wt% loss
Segment 1	80.3	87.0	80.4	NM
Segment 2	82.4	87.0	85.7	80.6
Segment 3	86.0	85.0	81.8	88.5
Segment 4	77.3	82.8	79.9	89.5
Segment 5	80.9	88.0	78.2	88.8
Segment 6	No sample	No sample	75.8	84.4
Segment 7	76.8	84.8	71.7	85.8
Segment 8	76.6	85.6	75.4	84.8
Segment 9	75.8	71.0	76.0	85.2
Segment 9B	70.4	72.1	NA	NA
Composite 1	74.6	73.3	76.5	81.6
Composite 2	75.9	70.2	77.1	80.8

Table 5-19. Differential Scanning Calorimetry Energetics Results from Tank 241-T-111, Core 31 (wet basis).

Core sample 31	Transition 1			Transition 2		
	Range (°C)	Avg. onset (°C)	ΔH range (J/g)	Range (°C)	Avg. onset (°C)	ΔH range (J/g)
Segment 1	43 - 141	43	1,088 to 1,406	200 - 387	200	-259 to -273
Segment 2	46 - 149	46	1,108 to 1,643	200 - 398	225	-256 to -264
Segment 3	45 - 160	50	1,210 to 1,233	195 - 405	198	-263 to -448
Segment 4	44 - 165	44	1,235	200 - 390	200	-55.7
Segment 5	NR	--	Endotherm NR	NA	NA	No Exotherm
Segment 6	NA	--	---	---	--	NA
Segment 7	50 - 164	50	1,488	165 - 400	NA	No Exotherm
Segment 8	50 - 153	50	1,534	154 - 400	NA	No Exotherm
Segment 9	61 - 158	61	1,437	159 - 400	NA	No Exotherm
Composite 1	NR	--	Endotherm NR	256 - 339	257	-23.6 to -37.0
Composite 2	NR	--	Endotherm NR	260 - 334	262	-18.5 to -22.9

NOTE: To convert from J to cal, divide by 4.18.
NOTE: Negative ΔH indicates an exotherm.
NA = Not applicable.
NR = Not resolved.

Table 5-20. Differential Scanning Calorimetry Energetics Results from Tank 241-T-111, Core 33 (wet basis).

Core Sample	Transition 1			Transition 2		
	Range (°C)	Avg. onset (°C)	ΔH range (J/g)	Range (°C)	Avg. onset (°C)	ΔH range (J/g)
Segment 1	49 - 168	49	958 to 1,604	168 - 374	184	-218 to -293
Segment 2	45 - 179	50	1,346 to 1,496	168 - 438	174	-454 to -645
Segment 3	NA	--	Endotherm NR	237 - 400	237	-49.3
Segment 4	NA	--	Endotherm NR	NA	--	No Exotherm
Segment 5	NA	--	Endotherm NR	NA	--	No Exotherm
Segment 6	NA	--	Endotherm NR	NA	--	No Exotherm
Segment 7	NA	--	Endotherm NR	NA	--	No Exotherm
Segment 8	NA	--	Endotherm NR	NA	--	No Exotherm
Segment 9	NA	--	Endotherm NR	NA	--	No Exotherm
Composite 1	NA	--	Endotherm NR	NA	--	No Exotherm
Composite 2	NA	--	Endotherm NR	NA	--	No Exotherm

NOTE: To convert from J to cal, divide by 4.18.
NOTE: Negative ΔH indicates an exotherm.
NA = Not applicable.
NR = Not resolved.

Table 5-21. Differential Scanning Calorimetry Energetics Results from Tank 241-T-111, Core 33 (dry basis).

Laboratory-core sample-air/N_2	Transition 1			Transition 2		
	Range (°C)	Avg. onset (°C)	ΔH range (J/g)	Range (°C)	Avg. onset (°C)	ΔH range (J/g)
222-S core 33, seg. 1, Air	---	---	NR--Dried	158 - 405	NR	-1,857 to -1,882
222-S core 33, seg. 2, Air	---	---	NR--Dried	130 - 425	NR	-251 to -269
222-S core, 33 seg. 2, N_2	---	---	NR--Dried	130 - 430	NR	-288 to -309
222-S core 33, seg. 2, N_2	---	---	NR--Dried	128 - 418	NR	-180 to -187
222-S core 33, seg. 2, N_2	---	---	NR--Dried	123 - 421	NR	-163 to -175
222-S core 33, seg. 2, N_2	---	---	NR--Dried	121 - 438	NR	-336
325 core 33, seg. 2, N_2	---	---	NR--Dried	107 - 394	199	-836 to -898

NOTE: To convert from J to cal, divide by 4.18.
NOTE: Negative ΔH indicates an exotherm.
NA = Not applicable.
NR = Not resolved.

Table 5-22. Additional Segment-level Physical Properties Measurements (1994).

Analyte	Core 31, segment 3		Core 31, segment 7		Core 33, segment 1		Core 33, segment 7	
	As-received	Centrifuged	As-received	Centrifuged	As-received	Centrifuged	As-received	Centrifuged
Gravimetric water (%)	79.53	64.96	74.72	62.06	79.56	65.49	74.07	59.95
TGA (%)	76.72	55.36	74.06	55.83	78.08	51.37	78.1	45.15
Density (g/mL)	1.24	1.09	1.19	1.20	1.16	1.19	1.20	1.29
ΔH exotherm range (J/g)	-112 to -191	-465.3 to -546.9	-10.2 to -33.1	0	-249 to -254	-822.4 to -838.1	-37.5 to -41.4	0

When there is a second transition it is usually substantial and the energetic behavior is readily quantifiable in all of the samples analyzed where exotherms are observed. Any weight loss in the second transition region (generally temperatures above 200° C) was not readily quantifiable, whether exotherms were observed or not. The results for the samples from segments 1, 2, and 3, which are from the upper portion of the tank, indicate significant differences in thermal behavior compared to other samples from deeper in the tank, further suggesting a difference in waste type. In addition, because of the observed exothermic behavior for the top 3 segments from cores 31 and 33 and the results from Baldwin (1994), the present TOC assay is not considered capable of measuring the TOC in the waste. Resolution of the actual magnitude of the exotherm, its reaction mechanism, and speciation of the fuel is still continuing.

5.5 OVERALL ANALYTICAL DATA SUMMARY

Several characterization and safety issues are defined by certain bulk amounts or weight percent of a given analyte. Table 5-23 presents the nominal concentration and calculated bulk amounts of the analytes in the waste matrix. The gross waste inventory in the tank is estimated to be 2,171,000 kg wet solid. It is assumed that by the publication of this report, no drainable liquid will remain in the tank. Appendix C presents the data, assumptions, and calculations used to determine the following values.

Table 5-23. Overall Data Summary and Inventory Estimates. (3 pages)

GROUP	Process history[1] (Agnew 1994)	TRAC (Jungfleisch 1984)	Analytical data range (most quantitative assay)	1992 cores 31 and 33 average	Tank inventory based on 1992 core data
CATIONS	µg/g	µg/g	µg/g	µg/g	kgs
Be.f	---	---	< DL	< DL	< 0.22
B.a	---	---	23.4 - 32.2	28	60.8
Na.f	74,200	0	33,900 - 39,800	37,000	80,300
Mg.a	---	---	290 - 479	377	820
Al.f	0	0	459 - 693	570	1,240
Si.f	2,800	0	5,410 - 5,960	5,670	12,300
P.f	(as PO_4^{3-})	(as PO_4^{3-})	9,070 - 11,600	10,400	22,600
S.f	(as SO_4^{2-})	(as SO_4^{2-})	1,080 - 1,350	1,230	2,660
K.a	3,700	0	1,020 - 1,210	1,140	2,460
Ca.f	0	0	2,050 - 2,760	2,420	5,260
Ti.f	---	---	22.3 - 72.9	48	104
V.f	---	---	12.1 - 16.5	14.5	31.5
Cr.a	33	719	1,840 - 2,140	1,980	4,290
Mn.a	90	507	6,140 - 6,710	6,330	13,700
Fe.f	9,400	10,300	15,900 - 20,500	18,500	40,200
Ni.a	0	0	108 - 151	132	285
Co.f	---	---	10.1 - 13.3	4.5	9
Cu.f	---	---	22.1 - 36.3	29.3	63
Zn.f	---	---	104 - 110	106	231
As.a	---	---	< DL	< 3.3	< 7.2
Se.a	---	---	< DL	< 1.5	< 3.3
Sr.f	0	---	280 - 334	300	651
Zr.f	0	0	4	NR	---
Ag.f	---	0	37.1 - 221	130	278
Cd.f	---	---	6.42 -10.7	5.8	12.6
Sn.a	---	---	1.61 - 4.21	2.5	5.4
Sb.a	---	---	22.6 - 36.5	31.4	70
Ba.a	---	0	57.0 - 87.3	69	150
La.a	12,700	512	3,620 - 4,890	4,220	9,160

Table 5-23. Overall Data Summary and Inventory Estimates. (3 pages)

GROUP	Process history[1] (Agnew 1994)	TRAC (Jungfleisch 1984)	Analytical data range (most quantitative assay)	1992 cores 31 and 33 average	Tank inventory based on 1992 core data
CATIONS	µg/g	µg/g	µg/g	µg/g	kgs
Ce.a	0	0	28.6 - 37.8	33.7	73.2
Hg.CVAA	---	---	1.08 - 1.83	1.43	3.1
Pb.f	0	0	267 - 484	365	792
Bi.a	23,200	963,000	23,300 - 28,500	26,000	56,300
U.LF	140	---	1,950 - 5,200	3,550	7,700
RADIONUCLIDES					
Analyte	µCi/g	µCi/g	µCi/g	µCi/g	Ci
Total Alpha	---	---	0.166 - 0.649	0.368	NA
Total Beta	---	---	8.83 - 21.5	15.1	NA
^{241}Am	---	0.0092	0.0382 - 0.0478	0.0425	92.4
$^{239/240}Pu$	0.009	0.055	0.134 - 0.628	0.304	660
^{137}Cs	0.086	0	0.103 - 0.237	0.166	360
^{99}Tc	---	0	0.00473 - 0.0114	0.0079	17.2
^{59}Ni	---	---	3.35E-05 - 9.4E-05	5.04E-05	0.11
^{63}Ni	---	---	0.0036 - 0.011	0.0057	12.4
^{90}Sr	0.176	1.84	3.43 - 7.43	5.41	11,800
^{14}C	---	0	< DL	< DL	---
^{3}H	---	---	< DL	< DL	---
ANIONS					
Analyte	µg/g	µg/g	µg/g	µg/g	kgs
OH^-	8,900	15,700	3,300 - 6,000 [2]	---	---
NH_3	---	---	< DL	< DL	---
F^-	24,600	0	1,370 - 3,130	2,300	4,990
Cl^-	0	0	400 - 500	450	977
NO_2^-	0	0	525 - 952	793	1,720
NO_3^-	51,600	0	36,900 - 44,300	41,300	89,660
CO_3^-	0	0	as TIC	812	1,760
Total PO_4^{-3}	35,400	438,000	27,800 - 35,500	31,900	70,100

Table 5-23. Overall Data Summary and Inventory Estimates. (3 pages)

GROUP	Process history[1] (Agnew 1994)	TRAC (Jungfleisch 1984)	Analytical data range (most quantitative assay)	1992 cores 31 and 33 average	Tank inventory based on 1992 core data
CATIONS	µg/g	µg/g	µg/g	µg/g	kgs
ANIONS					
SO_4^{-2}	1,450	0	3,290 - 3,690	3,680	7,990
CARBON-BEARING SPECIES					
Analyte	µg/g	µg/g	µg/g	µg/g	Kgs
TOC	2,000	---	2,000 - 3,990	3,120	6,770
TIC	---	0	650 - 950	812	1,760
$C_2H_3O_2^-$	0	0	NM	---	---
$C_2O_4^{2-}$	7,200	---	NM	---	---
$C_6H_5O_7^-$	0	0	NM	---	---
$Fe(CN)_6^{4-}$	0	0	NM	---	---
EDTA	0	0	NM	---	---
HEDTA	0	0	NM	---	---
PHYSICAL PROPERTIES					
Wt% Water (Grav.)	72.5%	---	74.6 - 77.1	76.0%	1.65E+06 kg
Wt% Water (TGA)	72.5%	---	70.2 - 81.6	76.5%	1.66E+06 kg
Bulk Density (g/cm^3)	1.21	1.8	1.19 - 1.28	1.24	---
Supernatant Density (g/cm^3)	1.058	---	1.033 - 1.038	1.036	---

[1]Process history estimates are determined using a simple linear combination based on the proportions of 2C and 224 waste contributed.

[2]OH^- is estimated from mass and charge imbalance.

6.0 INTERPRETATION OF ANALYTICAL RESULTS

Tank 241-T-111 had a relatively straightforward process history as documented in the transfer records. It received very few major types of waste that were likely to deposit solids during its operating history. The waste types, in chronological order, were as follows:

- 2C waste
- 224 Waste
- Decontamination streams from T Plant (221-T).

The purpose of this section is to attempt to identify and reconcile the location of the tank waste solids, thereby estimate the tank inventory for various analytes of importance.

The waste profile was identified by examining the available segment level assays for analytes or characteristics distinct to the waste types that were disposed in the tank, and then combining that information with what is known regarding the tank's process history. The first waste placed in the tank through the cascade inlet from tank 241-T-110 was 2C waste. Study of the process stream compositions indicates that this waste would be comparatively high in bismuth and phosphate in addition to the ubiquitous sodium, nitrate, and iron found in nearly all waste types. Elevated levels of fluoride, chromium, and sulfate are also expected. Qualitatively, the waste has been observed to be a gelatinous material. Anecdotal reports during this time also indicate that the cascade lines may have clogged in tank 241-T-111 and in other tank cascades receiving this type of waste. The 2C solids volume was measured to be between 723,000 L (191,000 gal) and 931,000 (246,000 gal) in 1953 (Anderson 1990).

The tank then received 224 waste. The solids from this waste are high in manganese, lanthanum, and fluoride, however, the 224 waste may have been combined with the 2C waste before being discharged to the tank. The estimated solids volume contribution for this waste type in tank 241-T-111 at the end of bismuth phosphate production in T Plant was between 594,000 and 802,000 L (157,000 and 212,000 gal).

The last major waste type disposed in the tank was T-Plant decontamination waste. Much of the physical and chemical composition of this waste is unknown because it was a catch-all, consisting of various process residues, unused stock solutions, and aqueous decontamination solutions that contained surfactants (such as Turco*). Few predictions can be made from

*Turco is a registered trademark of Turco Products, Inc.

studying the historical process flowsheets in this case. Lack of analytical data and/or transfer records with regard to T-Plant effluents later in tank 241-T-111's service life are a great source of uncertainty regarding the waste near the surface. One observation is that slightly higher TOC values may be anticipated near the surface because of the use of detergents in the decontamination waste stream and its chronological discharge sequence with respect to the other wastes. This waste stream is estimated to occupy the top segment of waste, or 198,000 L (53,000 gal). The sum of the wastes would range between 1.52 million L and 1.93 million L (401,000 gal and 511,000 gallons), well within the reported range described in Anderson (1990). This waste volume would measure between 389.4 to 491.0 cm (153.3 to 193.3 in), measured from the centerline and distributed evenly across the tank. The present surveillance level status is almost exactly in the middle of this range 1.73 million L (456,000 gal) and 440.2 cm $\pm$ 1.3 cm (173.3 $\pm$ 0.5 in) (Rios 1994).

Two common characteristics of all these waste types are high water content and relatively low activity. None of the waste streams disposed in this tank were concentrated through the evaporator; therefore, the waste tank would not have any salt cake. The uranium, plutonium, and fission product content of these wastes are uniformly low.

6.1 Review of the Analyte Profiles

The following conclusions are drawn from review of the available composite and segment analyses presented in Section 5, and the historical information presented in Section 2.

Core 31

The chemical analyses of core 31 indicate there are at least two primary types of material in distinct layers in the tank. The DSC traces for segments 1, 2, and 3 show exotherms far out of proportion to the measured organic content in the wastes. The temperature range where the wastes begin to show reactions are from 170 to 400° C, but do not appear to be self-sustaining. Instead, the overall energy profile is highly endothermic, probably caused by the large amount of bound water (70 to 80 weight percent) that is evaporated from the sample before a reaction is initiated. The overall physical and chemical properties of the waste in the tank roughly correspond to the expected behavior and composition of 2C waste, with large quantities of bismuth, iron, and phosphorous, and no exothermic behavior. But, there is a substantial contribution of manganese and lanthanum in the composites. However, these analytes can be found in 224 waste, and historical data indicates that 224 waste was added to tank 241-T-111 later in its service life. Therefore, the analytical and historical data correspond reasonably well, except for the anomalous energetic results. At this time, there is no adequate explanation for the observed exotherms in the upper segments of tank 241-T-111 waste.

Core 32

Every segment of core 32 was compromised during the sampling process in some fashion. When the sampler operated properly, liquids were the only material recovered from this core. However, the sampler valve failed repeatedly. Photographs taken before and after the sampling event reveal that there was a plastic bag in the vicinity of the sampling area before coring operations. After core sampling, the bag can not be seen. It is surmised that the sampling drill string was obstructed by the bag during core sampling operations, causing the corruption of the samples. All samples from core 32 were rendered unusable or categorized as non-representative. Therefore, no assays were performed and no analytical results are reported.

Core 33

The chemical analyses of core 33 indicate there probably are three primary types of material in distinct layers in the tank. The extremely high manganese values in the top first segment of the tank are attributed to a combination of T-Plant decontamination waste (i.e. the result of a final process flush during the decontamination of T Plant) and 224-waste solids deposited late in the tank's service life. Proceeding deeper into the tank, beneath the first segment, the distribution of bismuth, manganese, lanthanum, and chromium in the composites and the analyte profiles from the homogenization results through segment 3 support the conclusion that this material is still 224 waste. Segment 3 itself is suspected to be a transition layer, containing the boundary between the 224 waste and the 2C waste, based on the exothermic behavior of the waste as a function of depth. The TOC analysis indicates moderate amounts of residual organics in the waste.

Cesium - 137 concentrations between the core composites vary within a factor of two, and the variation in the ^{241}Am is less than 13 percent. But the change in concentration as a function of depth for each of these analytes is much more significant. Both analyte profiles show a decreasing trend as a function of depth in core 33. The ^{137}Cs concentration decreases by more than a factor of 30 over the depth of the tank, and ^{241}Am decreases by a factor of 10 through segment 7 before rebounding somewhat in segment 9. The ^{137}Cs and ^{241}Am concentrations as a function of depth in core 33 show profiles consistent with the wastes believed to be associated with the segments: low overall ^{137}Cs and ^{241}Am values. But the relative radionuclide concentrations for the suspected 224 and T-Plant decontamination wastes are higher than the 2C wastes. The ^{90}Sr concentration is also low, and ^{90}Sr is similar to ^{137}Cs in the magnitude of the change in concentration and as a function of location for both cores. However, there are no high radionuclide values anywhere in the tank, and the tank temperature further confirms the tank's low radionuclide content.

Lanthanum and phosphate/phosphorus demonstrate an increasing concentration profile as a function of depth. Between segments 1 and 3 and 3 and 5 there is an abrupt change in the concentrations of calcium, chromium, manganese, bismuth, lanthanum, and phosphorous, although after segment 5, the analyte concentrations tend to plateau, mirroring the behavior

of the radionuclides. In addition, the DSC traces for segments 1, 2, and 3 show exotherms far out of proportion to the measured organic content in the waste. The temperatures where the wastes begin to show reactions range from 170 to 400 °C, but these reactions do not appear to be self-sustaining. Instead, the overall energy release is highly endothermic, probably from the large amount of bound water that is evaporated from the sample before a reaction is initiated.

In conclusion, the physical and chemical properties of the waste in the bottom half of the tank correspond to the expected behavior and composition of 2C waste, and the upper half of the tank is suspected to be 224 waste with a high manganese layer located in segment 1. Therefore, the analytical and historical data correspond well with the historical fill pattern, except for the anomalous energetic results. Presently there is no adequate explanation for the observed exotherms in the upper segments of tank 241-T-111 waste.

6.1.1 Entrance, Exit, and Mixing Effects on Analyte Distribution

Figure 5-1 shows an elevation and plan view of where the core samples were taken. Important items to note are the arrangement and location of the risers and cascade lines (inlet and outlet). Their configuration can have a substantial impact on the distribution of waste in the tank, and observations with regard to sampling. However, the waste entrance and exit points for the tank over its service life are not well documented, therefore the spatial relationship and proximity to the sample risers is not known. The decant "float and flex" pump contained a 6.1-m (20-ft) section of flexible hose that could traverse a relatively wide area under and around the pumpout riser. The cascade fill line where 2C waste entered the tank is closer to the core 33 sample point than to the core 31 sample point. There was very limited discharge/transfer traffic from the other separations plants within T farm or with the tank farms as a whole, so no highly enriched layer of radioactive material is expected to lie on top of the waste as has been observed in other tanks sampled. However, the relative concentration of radionuclides is observed to be higher in the upper portions of the tank.

As new wastes entered the tank and were distributed across it, the material under and around the tank pumpout could have been disturbed, and occasionally solids could have been transferred, in behavior similar to the last in, first out principle. It is believed that the material beneath the waste inlets, the cascades and perhaps a riser, would have been disturbed initially, but over time, large stratified layers resistant to mixing eventually would have built up. No deliberate mixing of the wastes was performed; therefore, where segment-level data is available, distinctions between waste types can be made. Some of the larger particulate materials discharged to the tank initially may have settled out near the inlet because they were not as flocculent or as easily suspended as some of the other solids. This settling behavior may have provided a slight degree of separation. Therefore, the influence of the waste inlet and outlet locations can provide insight to the analyte distribution and waste profiles between cores 31 and 33. These factors may account for the nominally observed lateral heterogeneity between cores 31 and 33; however, it must be noted that this lateral

heterogeneity is very slight and there may be several other factors contributing to this observation.

6.1.2 Waste Profile

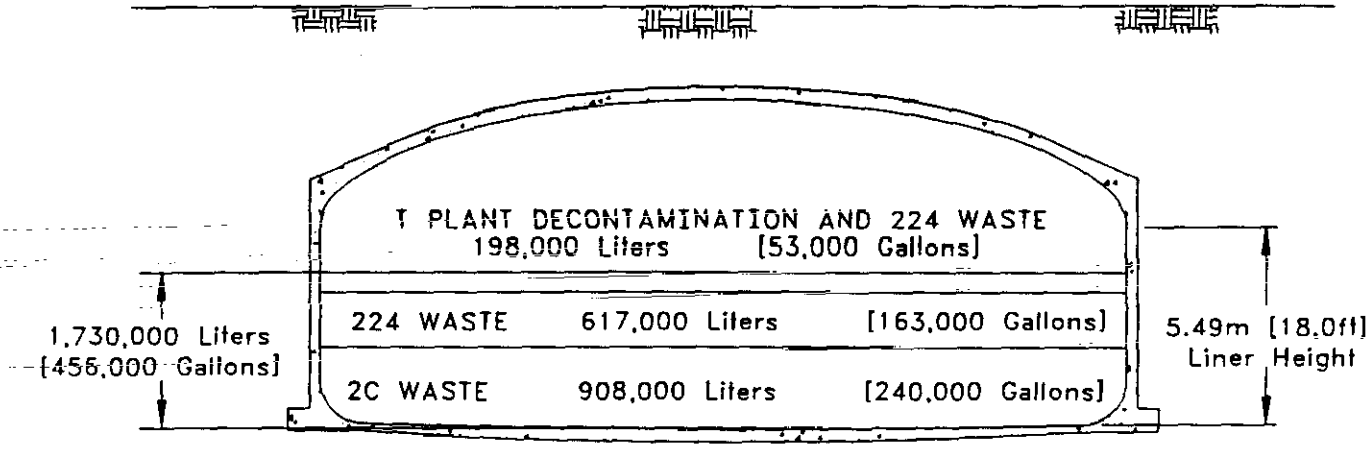
Given the historical and analytical data, it is possible to develop a rough representation of the wastes as they presently are configured in tank 241-T-111. Figure 6-1 shows a representation of the overall waste profile of tank 241-T-111 and the assumed volumes, boundaries, and positions of the various individual layers as they are believed to exist.

6.2 WASTE SUMMARY AND CONDITIONS

Historically, 241-T-111 was a non-watch list single-shell tank with no previous indication of a potential safety issues. All waste receipts were 2C waste, 224 waste, or residues from the T-Plant cleanout. Flowsheet records indicate that small amounts of oxalate are present in 224 waste (at 0.028 M) (Schneider 1951). As a result of DSC measurements, tank 241-T-111 was added to the Organic Watch List on March 4, 1994 and further concerns have been raised about the tank's integrity.

When tank 241-T-111 was sampled, normal paraffin hydrocarbon was used as a hydrostatic fluid, presenting a potential contamination source and bias for the DSC. However, when taking the first segment, no normal paraffin hydrocarbon was used, and sample recovery for the other segments in the cores was excellent. No voids or separable liquid layer were observed on extrusion of the samples, and results from the gas chromatograph/mass spectrometer for normal paraffin hydrocarbons components showed only trace amounts, precluding significant sample contamination from the hydrostatic head fluid. Furthermore, experiments have demonstrated that normal paraffin hydrocarbons steam distill away before reaching the reaction temperatures observed in DSC assays of the samples. In the deeper segments and in the composites, core 31 demonstrates some activity, but not to the extent shown in the upper segments. In core 33, no significant exotherms are evident in the composite. The photographs of the extruded waste material demonstrated that the all of the core samples were viscous, gel-like materials with very little free liquid, and that they held their shape relatively well. During the physical testing of the core 31, segment 2 solid sample, when the sample was centrifuged, there was some separation of free water from the gel. Later physical testing did show some separation of liquid from the waste matrix for segment 7, but again, no separable phase was observed in the liquid (Delegard 1994). In each case, the liquid did not appear to have any distinct layers, therefore no liquid organics are considered to contribute to this waste matrix. In addition, although historically there have been problems with both volatile and semi-volatile organics analysis methods and

Figure 6-1. Waste Profile of Tank 241-T-111.



- Dished bottom and tank layer 1: 2C, 908,000 L (240,000 gal)
- Tank layer 2: 224 waste, 617,000 L (163,000 gal)
- Tank layer 3: T-Plant decontamination and 224 wastes, 198,000 L (53,000 gal)

holding times on these samples, all of the results from these assays show levels of these compounds below EPA contract laboratory procedure quantitation limits.

This information, coupled with data from the organic vapor monitor taken during the recent liquid sample effort (Appendix C), supports the contention that there are no substantial liquid organics in the tank. The organic vapor monitor results from the vapor space of tank 241-T-111 show a reading of 9.2 parts per million over a three minute monitoring interval: a detectable concentration, but far below the established safety criterion of 20 percent of the lower flammability limit. This result from the organic vapor monitor is not unexpected because small quantities of ammonia were observed in the grab samples and historically ammonia was used as a process chemical in the tank wastes. Over time, the ammonia is believed to have dissipated slowly to the levels observed today. It is also believed that the vapor space of this tank is relatively homogenous, and therefore, large concentration gradients for organics and other materials in the vapor space are not plausible. Differences of 2 to 10 times are within the realm of possibility (10 times being an extreme). Factors higher than that are not considered credible. For comparison, the vapor space of tank 241-C-103, which has a known organic liquid layer, was found to be 200 ppm. Furthermore, a simplified modeling scenario of tank 241-T-111 shows that if normal-paraffin-hydrocarbon-type liquid organics were present, they would be in much greater quantities than detected in the organic vapor monitor (see Appendix C).

To conclude, the waste in tank 241-T-111 is a complex material, primarily made up of water and organic and inorganic salts in a gel-like matrix. The insoluble solids are a mixture of phosphates, silicates, hydrated oxides, and hydroxides in combination with calcium, chromium, lanthanum, iron, bismuth, manganese, and uranium. The soluble analytes are primarily sodium, nitrate, sulfate, and fluoride. Phosphorous is nearly evenly divided between its soluble and insoluble forms. Substantial exotherms were detected in segments 1, 2, and 3, with the reactivity tailing off in segment 4 of core 31 and in segments 1, and 2, with the reactivity tailing off in segment 3 of core 33. The exotherms were reported to be similar in size and temperature range. It is important to note that no exotherms are observed until the sample has been dried and heated to approximately 180 °C. The exotherms themselves do not appear to be kinetically fast, thus the reaction may not be able to sustain itself without being thermally driven, as they are in the DSC apparatus. The organics present appear to be in the form of slightly soluble salts, contributing to a gel or sol-like structure. This behavior would be consistent with the very high moisture content observed in these tanks and with the types of organics historically indicated to be in the waste: aqueous decontamination solutions using surfactants, not normal paraffin hydrocarbons or TBP-type organics. This would help explain their low volatility and reactivity, their presence in the solid phase, and their relative absence in the liquids. These materials are carbon-bearing and will, if given enough impetus in the form of a thermal driver, react; however, the reaction does not appear rapid or self-sustaining, and will not occur without first removing the water from the gel. No other safety issue was found after critically reviewing the analytical, historical, and surveillance data.

Hypotheses Regarding Recent Behavior of 241-T-111

Recently, surveillance data indicated that there had been a relatively abrupt level change in tank 241-T-111 over the past 16 to 18 months. Approximately 2.5 cm (1 in) of gradual sludge growth was observed over the last eight-year period, followed by an approximately 4.1-cm (1.6-in) decrease in surface level over 16 months. This situation is cause for concern. Tank 241-T-111 is an assumed leaker, therefore there is the possibility that the tank has leaked again and waste is being lost to the environment. This is not an acceptable condition. *Tank Farm Operating Procedures* (Boyles 1992) specify that when a level drop in a tank is observed, the observation must be accompanied by certain actions, and that a leaking tank must be pumped to eliminate any remaining drainable liquid to prevent further environmental contamination. However, the observed level decrease was not large enough to trigger action past investigation under present guidelines (Boyles 1992), and it was not resolved that a leak was the only explanation for the observed behavior. In fact, there were observers who believed there was another safety issue requiring consideration involved. The final outcome of the review, however, was the decision to pump the liquid in the saltwell of tank 241-T-111 to tank 241-SY-102 (Jenkins and Engelman 1994). This section recaps some of the alternative explanations presented for the surveillance data and provides some of the strongest and weakest points of the arguments put forth.

- Tank is a "Re-leaker"

  Evidence supporting this point of view is strong and it is one of the most favored explanations for the observed level drop. Tank integrity was questionable for a long period of time, and the tank was declared a leaker in 1984. Corrosion of tank liner is also evident from in-tank photographs. However, the change in surface level could be a localized phenomenon and in-tank photographs and observations of the extruded core material indicate that the waste is viscous and cohesive. Substantial damage to the tank liner and shell would be necessary for the evacuation of over 11,000 L (3,000 gal) of material and this condition is not indicated.

- Long Cycle Gas-Release Tank

  This proposition is more speculative, but warrants consideration. Cyclic, gas generating behavior previously has been observed in Hanford-Site waste tanks. Specifically, tank 241-T-110, the cascade source for tank 241-T-111, is on the Gas-Generation Watch List. Viscous waste material, such as that observed in tank 241-T-111, also appears to be able to retain generated gases. However, overall tank information, specifically the analytical chemistry results, indicate tank conditions necessary for gas generation as currently understood (i.e. high radionuclide and complexant levels), do not exist.

- Intrinsic Waste Matrix Changes

  This explanation is even more tenuous than the previous one, but again, the present understanding of the high-level waste tank matrices is very limited, so it is within the realm of possibility. Composition and structure of the waste (small particles, high water content, high ionic strength solution, and possible organic surfactants), may be similar to an emulsion. Over time, the low-level radiolytic action and thermal cycling of the waste may break down the colloidal characteristics of the matrix. The breakdown may be uneven, and there may even be a slurry-growth phase before the separation of the emulsion and the loss of free water through pinhole corrosion. However, that same degree of uncertainty regarding the content and structure of the waste matrix makes this hypothesis highly speculative without much more characterization information than currently exists.

- Structural Subsidence of the Waste

  This particular condition may be a contributing factor to the observed behavior, since it is acknowledged that the overall configuration of the waste generally is not very well known (and that the surfaces of the waste beds can be highly irregular), however it is not considered the main cause. After disposal into the tank, irregularities in the waste bed may have formed. The shifting of the waste bed over time as a result of gravitational compression is potentially responsible for the sudden drop in waste level. However, this rationale does not adequately explain the observed increase in tank level without involving another agent (i.e. a slow tank intrusion). Also, further slumping of the waste was not observed in the recent in-tank photographs, and the waste surface was observed to be reasonably uniform.

- Other Possibilities or Combinations of the Preceding Agents

  There may be more than one mechanism involved in the observed behavior, such as a long-term slow intrusion coupled with a subsequent upset and relatively rapid loss of material, especially of liquid, because the matrix appears to be quite viscous. There are a limited number of measurements taken and their location is fixed; therefore, local irregularities may be exacerbated. In addition, measurement error and bias also are significant when considering the magnitude of the drop in comparison with the error band.

6.3 TWRS PROGRAM ELEMENT CHARACTERIZATION SYNOPSIS

This section provides selected results obtained from core sampling for some of the most pertinent analytes for the various TWRS program elements, including vitrification, Retrieval, Pretreatment, and Waste Tank Safety. Analytes of interest will be reported on a level of resolution commensurate with the available data and program direction. Watch-list tanks will have segment or subsegment level analyses reported, while non-watch-list tanks are analyzed on a core composite basis. Analytes of interest to multiple programs generally will be reported only in one section. Further detail can be found in the body of the report or in the data packages.

6.3.1 Retrieval Program Data Summary: Physical Properties

A major objective of the characterization program is to measure the physical properties of the waste to support waste retrieval technology development. The analytical methods to determine the physical properties of the waste as it actually exists in the tank require 50 to 100 g of unhomogenized sample. In some cases, the limited amount of sample recovered constrains the number of analyses that can be performed. At the time of the sampling and analysis of tank 241-T-111 waste, no data quality objective existed to define the scope of the analyses. However, several analytes that specifically relate to physical properties were determined to be of interest to the program and are summarized here. The physical characteristics of tank waste are required to develop design criteria for waste retrieval equipment, provide a basis for simulated waste development, and to provide a basis for validation of equipment testing using design criteria and simulated waste. Selected rheological and physical properties are presented in Table 6-1. Further information regarding these analytes can be found in Section 5.3.

Table 6-1. Retrieval Program.

Analyte	Data range
Specific gravity (g/mL) --solids --liquids (grab sample)	 1.19 - 1.28 1.036
Shear strength	5,000 ± 2,300 dynes/cm^2
Viscosity (mPa•s) --1:1 dilution @ 29 °C	 Less than 2 mPa•s (cP)
Settled solids (Vol %)	100%
Weight % solids	22.4 to 29.3
Weight % undissolved solids	19.0 to 25.4
Particle size (μm) --number distribution --volume distribution	 85% < 2 μm 70% < 24 μm

6.3.2 Final Disposal Program Data Summary

Bulk Constituent Concentrations for Pretreatment

Programmatic decisions pertaining to the design of pretreatment and final disposal systems shall be based upon the average characteristics of the tank waste. Therefore, the majority of the laboratory analyses shall be conducted on representative core composites. However, as noted in other documentation (Bell 1993), segment, subsegment, and additional analyses will be performed when directed. The constituent concentrations and inventories shall be calculated by either treating the core samples as random samples and averaging the results, or by using a spatial model. The calculated values will include an estimated total quantity of each selected analyte and its corresponding confidence interval (CI) based upon analytical and sampling variability. Again, no data quality objective existed to define the scope of the analyses at the time tank 241-T-111 was sampled and analyzed. However, several analytes relating specifically to the most significant chemical and radiological contributors and their solubility properties were determined to be of interest to the program and are summarized here. Chemical analytes of interest are presented in Table 6-2. Trace analytes and more comprehensive chemical and radiological characterization information can be found in Section 5.

Low-level and High-Level Vitrification Program

The final disposal option for Hanford-Site wastes has been determined to be vitrification after partitioning into low-level and high-level fractions. This program has characterization needs in addition to those described for core sampling. The vitrification process will be performed after the solids have been pretreated. Therefore, the core sample information will provide preliminary bounding design conditions for the vitrification plant. Further characterization for technology development and regulatory compliance will be necessary on the pretreated waste that will be fed to the vitrification plant. Although the data requirements for this option are not formally defined, the analytical requirements for the previous Hanford Waste Vitrification program generally are applicable and are identified in the *Hanford Waste Vitrification Plant Feed Characterization Requirements*, Revision 4 (Wagner 1992). These requirements are quite similar to the pretreatment program requirements, and therefore are presented together in this section (see Table 6-2). For more specific information on a particular analyte not given in this table, consult the data package (McKinney, et al. 1993) or the appropriate table in Section 5.

The analytical program for vitrification not only entails determining if a waste type is suitable for disposal as glass, but also includes determining the physical and chemical characteristics of the glass for process-control purposes and to ensure regulatory compliance. Sampling and analysis plans will be developed on an individual basis for each tank or process batch. The characterization needs for these efforts include analyses for metals, water-soluble anions, radionuclides, semi-volatile organics, and rheological and physical testing for both the feed and vitrified product.

Table 6-2. Concentrations and Solubility of Principal Waste Components.

Analyte	Tank average concentration water prep: (μg/g)	Tank average concentration fusion prep: (μg/g)	% Water soluble
Calcium	61.8	2,420	2.55
Chromium	218.3	1,980	11.03
Iron	127.7	18,500	0.69
Aluminum	10.9	570	1.91
Sodium	33,000	37,000	89.19
Bismuth	201.8	26,000	0.78
Lanthanum	11.0	4,220	0.26
Silicon	571.8	5,670	10.08
Uranium	No measurement	3,550	---
Zirconium	0.8	4.0	20.00
Phosphate	15,600 (IC)	32,300	48.29
Sulfate	3,550 (IC)	3,680	96.47
Nitrate	41,300	Not Applicable	---
Fluoride	2,300	Not Applicable	---
TOC	3,120	Not Applicable	---
Radionuclides	(μCi/g)	(μCi/g)	
^{90}Sr	0.00097 (Grab)	5.41	0.018
^{137}Cs	0.087 (Grab)	0.166	52.33

Tank 241-T-111 presently is not scheduled as an early feed for pretreatment and vitrification. The following characterization objectives need to be addressed in a data quality objective supporting the design of retrieval, pretreatment, and final disposal systems for early feed tanks.

- Provide extensive characterization of the chemical and radiological contents of the waste (solids and supernate) as it currently exists in the tanks to evaluate how it can be processed and to verify if the composition variability study envelope coverage for key analytes is adequate.

- Estimate the waste fraction that will remain after sludge wash pretreatment and estimate the feeds for the low-level and high-level streams for vitrification.
- Simulate sludge washing pretreatment on the waste material. This will provide a detailed understanding of the sludge wash process and obtain empirical data on soluble species removal.
- Determine the physical and rheological properties of the waste before and after simulated sludge washing to support the design of a waste retrieval system.
- Provide a supply of sludge washed material to be used as feed material for a laboratory scale vitrification.
- Satisfy the general characterization requirements for physical, chemical, and radiological analytes.

6.3.3 Waste Tank Safety Program Characterization Data Summary

Safety Screening

The tank safety screening data quality objective will be used to classify 149 SSTs and 28 double-shell tanks that contain high-level radioactive waste into specific safety categories for issues dealing with the presence of ferrocyanide, organics, flammable gases, and criticality (Babad and Redus 1994). The analytes used to make this classification are fuel energy value, total alpha concentration, weight percent moisture, and gas composition. The following table presents the analytes of concern, the criterion for classification, and the analytical result from the tank, where available. Further information on the tank contents are presented in subsequent sections. Because of the exothermic response of the waste material from the upper portions of tank 241-T-111, it has been placed on the Organic Watch List, and further studies trying to resolve the nature of the observed reaction are continuing. Table 6-3 provides a comparison of the tank values with the safety screening criteria.

Table 6-3. Tank 241-T-111 Comparison to Safety Screening Criteria.

Analyte	Safety issue/criteria	Tank result
Fuel energy value (cal/dry g)	Organics, ferrocyanide, flammable gas; -125 cal/dry g	Greater than -215 cal/dry g
Total alpha concentration	Criticality; 1 g ^{239}Pu/L	0.0053 g/L
Percent moisture	Organics, ferrocyanide, flammable gas; 17 wt%	76 wt%
Gas composition	25% lower flammability limit	NA

NA = Not available

Criticality Safety

The criticality safety program has indicated that plutonium and uranium isotopic analyses on each core composite and the bottom six inches of each core is required to alleviate the concern for the potential of tank criticality. Therefore, upon extruding the last segment in a core, the waste to be tested shall be homogenized before a small aliquot is taken and analyzed for plutonium and uranium isotopic analyses by mass spectroscopy. The analyses will indicate whether the fissile species have settled in a concentrated layer at the bottom of a tank. However, this analytical criterion was established after the sampling and analysis of tank 241-T-111 waste. Tables 6-4 and 6-5 present a summary of the core composite data for uranium and plutonium concentration. After reviewing the data, the isotopic analyses from both cores 31 and 33 were found to be very consistent with regard to composition, and the total alpha content indicated from the core 33, segment 9 homogenization data is extremely low (0.262 μCi/g). Therefore further re-analysis and isotopic resolution of the core sample material from the lower portion of cores 31 and 33, segment 9 is not warranted. For this tank to exceed established operating limits for fissile material in the tank farms, a concentration of 1.58 μCi/g $^{239/240}$Pu was calculated as a threshold limit value (see Appendix C).

Table 6-4. Core Composite Uranium.

Core No.	U_{FL} (222-S) (μg/g)	U_{FL} (325) (μg/g)	^{238}U mass percent	^{235}U mass percent
Core 31, composite 1	2,180	4,000	99.3074	0.6755
Core 31, composite 2	3,880	5,200	99.3098	0.6761
Core 33, composite 1	3,180	4,500	99.3125	0.6761
Core 33, composite 2	1,950	3,500	99.3161	0.6717

FL = Uranium measurement by laser fluorimetry.

Table 6-5. Plutonium Concentration and Isotopic Distribution

Core number	Total Pu α (222-S) (μCi/g)	Total Pu α (325) (μCi/g)	^{238}Pu mass percent	^{239}Pu mass percent	^{240}Pu mass percent	^{241}Pu mass percent	^{242}Pu mass percent
Core 31 C1	0.138	0.628	0.005	96.7199	3.2109	0.0352	0.0151
Core 31 C2	0.136	0.565	0.0105	96.6351	3.2834	0.0496	0.0215
Core 33 C1	0.134	0.319	0.004	96.7540	3.1046	0.1071	0.0683
Core 33 C2	0.147	0.368	0.0105	96.5499	3.3436	0.0621	0.0337

Organic Tanks

The following characterization objectives support resolution of this unreviewed safety question and safety issue and support retrieval, pretreatment, and final disposal systems design. Table 6-6 provides a comparison of the tank core composite values with the Organic Data Quality Objective Criteria.

- Determine the overall waste energetics and properties governing waste reactivity behavior in the tanks.
- Determine the spatial distribution of ^{137}Cs and ^{90}Sr.
- Determine the concentration of TOC and the speciation of organics present in the waste.
- Satisfy the general characterization requirements for physical, chemical, and radiological analytes.

Table 6-6. Data Quality Objective Decision Limits for Organic Tanks. (Babad 1994)

Analyte	Decision threshold	Tank result
TOC (Dry wt%)	> 5 wt% (dry basis)	1.3 wt% (tank) 4.1 wt% (Core 33, Seg. 2)
Moisture content (wt%)	< 17 wt%	76 wt%
Presence of organic layer	Yes/No	No
Tank temperature (°C)	90 °C	16 °C
Total fuel content	-125 cal/dry g	In excess of -215 cal/dry g

Further analysis and secondary analytes for measurement were found to be unwarranted for the tank composites; however, the first two segments of core 31 and three segments of core 33 will undergo additional study. The results from this series of assays will be incorporated into the revision of this characterization report as they become available.

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7.0 QUANTITATIVE/STATISTICAL INTERPRETATION OF THE DATA

This section contains the results of the statistical analysis of data from two core samples obtained from tank 241-T-111. Section 7.1 contains a description of the core-sample data used in the statistical analyses and some general observations regarding the data. Section 7.2 contains mean concentration estimates, and the associated 95 percent CIs, for each of the analytes in tank 241-T-111 waste. Section 7.3 contains estimates of the spatial variability (variability between cores), and estimates of the analytical error from the core composite data in tank 241-T-111. Further information can be found in Jensen (1994).

Two types of analytical error were estimated from the core composite data: variability between composite samples within the same core and variability between the primary and duplicate analyses within each core composite sample. Estimates of the analytical measurement error were used to test the significance of the spatial and compositing variability. Spatial variability was significant (i.e. substantially greater than zero at the 0.05 significance level) in 40 out of 79 analytes in the tank. The compositing variance was significant for 38 out of the 79 analytes.

7.1 APPROACH

Cores 31 and 33 were the two valid core samples taken from tank 241-T-111. The segment recoveries for each core were given previously in Section 4. Two core composite samples were made for each core from the homogenized solid segment waste. Primary and duplicate results were obtained from each core composite.

The ICP acid digestion, ICP fusion dissolution, ICP water leach, IC water leach analyses, selected radiochemistry, and other GEA were performed on all composite core samples. These were the analytical results used in the statistical treatment of the data. In the tables in Appendix B, the data are identified by the analysis method, the type of dissolution, and analyte; e.g., the notation ICP.a.Al refers to aluminum, acid digestion, and an ICP analysis. The core composite sample results used also are contained in Appendix B, together with ratios of the mean of each sample and duplicate divided by the detection limit for that pair. The data package for tank 241-T-111 (McKinney et al. 1993) contains a complete report of the sample results along with the laboratory quality control data. The core composite data for each analyte are illustrated in Appendix B.

Statistics were calculated for analytes with concentrations greater than 10 times their detection limits (DL). Personnel within the TWRS Information Management Systems have identified a list of analytes that have exception to this rule. Table 7-1 lists the analytes specified. Statistics were calculated for the analytes from this list if the concentrations were greater than three times their DL. For a number of analytes, the concentrations of some samples were greater than a particular limit (3 or 10 times the DL), while the other samples were less than that limit. In these cases the statistics were calculated using all of the data

whether it was above or below the particular limit (3 or 10 DL). The above rules do not apply to alpha or beta/gamma counting methods. The ratios (mean/DL) reported in Appendix B are provided to show how large the analyte concentrations are relative to the DL.

Table 7-1. Special Analyte List.

Aluminum	Nitrate
Bismuth	Nitrite
Calcium	Phosphate
Chromium	Carbonate
Iron	Fluoride
Silicon	Chloride
Sodium	TOC
Zirconium	Cyanide

A close examination of the figures in Appendix B reveals several outlier data points in the core composite data:

ICP.a.Co: The primary result for core 31, composite 2 of 11.7 ug/g is over three times the duplicate result. The other results for ICP.a.Co all fall in the range 2.7 ug/g to 3.8 ug/g. The detection limit for ICP.a.Co is 0.8 ug/g.

ICP.a.Cu: The duplicate result for core 31, composite 2 of 127 ug/g is about four times the primary result of 31.7 ug/g. The detection limit for ICP.a.Cu is 0.4 ug/g.

NO_2^-: Both the primary and duplicate results from composite 2 of core 31 are about half the results for core 31, composite 1. The average of the results for core 31, composite one is 952 ug/g; the average for composite two is 525 ug/g. The detection limit for NO_2 by water digestion spectrophometric analysis is 50 ug/g.

7.2 MEAN CONCENTRATION ESTIMATES

One of the tasks outlined as part of the waste characterization effort (Bell 1993, Winters et al. 1990a, Winters et al. 1990b), is to estimate the constituent inventories in the waste. The inventories are estimated by computing mean concentrations and 95 percent CIs on the mean concentrations for each constituent. The estimate of the inventory and CI on the inventory of an analyte in the tank are equal to the corresponding mean concentration estimates and CI multiplied by the volume of waste in the tank.

7.2.1 Statistical Methods

The concentration estimates are given in the form of 95 percent CIs on the mean concentration. It is assumed that each sample and its duplicate are analyzed independently of one another. The two analytical results are used to estimate the analytical measurement error. Because of the hierarchical structure of the data, the analytical measurement error alone is not the appropriate error term to use in computing the CIs. A linear combination of the analytical measurement variance and the spatial variance is the appropriate variance of the mean for the CIs. Appendix B contains a description of the statistical model and formulas used to calculate estimates of the mean, variance of the mean, and the CI on the mean.

7.2.2 Statistical Results

Table 7-2 contains the summary statistics by analyte for ICP acid digestion, ICP water leach, ICP fusion dissolution, IC, and selected radiochemical and physical analyses. The summary statistics are as follows:

$\bar{y}$	mean of the concentration data
$\hat{\sigma}^2(\bar{y})$	estimated variance of $\bar{y}$
df	degrees of freedom
95% LL	lower limit to the 95 percent CI on the mean
95% UL	upper limit to the 95 percent CI on the mean.

For some analytes the lower confidence limit (95 percent LL) was negative. Because concentrations are greater than or equal to zero, any negative 95 percent LL values were set equal to zero.

The CIs in Table 7-2 are wide relative to the range of the data. The CIs are wide because only two cores were used to estimate the spatial variability. A minimum of two core samples is needed to estimate a tank's spatial variability.

Table 7-2. Concentration Estimate Statistics. (4 pages)
(Units μg/g Except Radionuclides μCi/g)

Analyte	$\bar{y}$	$\hat{\sigma}^2(\bar{y})$	df	95% LL	95% UL
ICP.a.Ag	1.26E+02	7.86E+03	1	0.00	1.25E+03
ICP.a.Al	5.41E+02	1.06E+04	1	0.00	1.85E+03
ICP.a.B	2.80E+01	7.56E+00	1	0.00	6.30E+01
ICP.a.Ba	6.90E+01	6.46E+01	1	0.00	1.71E+02
ICP.a.Bi	2.59E+04	6.38E+06	1	0.00	5.80E+04
ICP.a.Ca	1.88E+03	2.12E+05	1	0.00	7.72E+03
ICP.a.Cd★	5.80E+00	3.03E+00	1	0.00	2.79E+01
ICP.a.Co●	4.30E+00	1.63E+00	1	0.00	2.05E+01
ICP.a.Cr★	1.98E+03	1.63E+04	1	3.57E+02	3.60E+03
ICP.a.Cu	3.35E+01	3.53E+02	1	0.00	2.72E+02
ICP.a.Fe	1.85E+04	1.21E+06	1	4.55E+03	3.25E+04
ICP.a.K	1.14E+03	2.24E+03	1	5.34E+02	1.74E+03
ICP.a.La	4.22E+03	3.00E+05	1	0.00	1.12E+04
ICP.a.Mg	3.77E+02	6.36E+03	1	0.00	1.39E+03
ICP.a.Mn	6.33E+03	2.68E+04	1	4.25E+03	8.41E+03
ICP.a.Na	3.69E+04	1.56E+06	1	2.10E+04	5.27E+04
ICP.a.Ni	1.32E+02	5.12E+02	1	0.00	4.19E+02
ICP.a.P	1.03E+04	1.21E+05	1	5.90E+03	1.47E+04
ICP.a.Pb	3.47E+02	2.64E+04	1	0.00	2.41E+03
ICP.a.S	1.21E+03	1.06E+03	1	8.00E+02	1.63E+03
ICP.a.Si	4.69E+02	9.17E+02	1	8.40E+01	8.54E+02
ICP.a.Sr	3.00E+02	3.75E+02	1	5.39E+01	5.46E+02
ICP.a.Ti	1.95E+01	1.39E+02	1	0.00	1.69E+02
ICP.a.V	1.45E+01	6.58E+00	1	0.00	4.71E+01
ICP.a.Zn	6.50E+01	6.46E+02	1	0.00	3.88E+02

Table 7-2. Concentration Estimate Statistics. (4 pages)
(Units μg/g Except Radionuclides μCi/g)

Analyte	$\bar{y}$	$\hat{\sigma}^2(\bar{y})$	df	95% LL	95% UL
ICP.f.Ag	1.28E+02	8.05E+03	1	0.00	1.27E+03
ICP.f.Al	5.70E+02	9.70E+03	1	0.00	1.82E+03
ICP.f.Ba	6.46E+01	2.45E+01	1	1.73E+00	1.28E+02
ICP.f.Bi	2.36E+04	9.08E+06	1	0.00	6.18E+04
ICP.f.Ca★	2.42E+03	8.27E+04	1	0.00	6.07E+03
ICP.f.Cd★	8.12E+00	1.76E+00	1	0.00	2.50E+01
ICP.f.Cr	1.80E+03	1.56E+03	1	1.30E+03	2.30E+03
ICP.f.Cu	2.93E+01	3.56E+01	1	0.00	1.05E+02
ICP.f.Fe	1.80E+04	4.05E+06	1	0.00	4.36E+04
ICP.f.La	4.11E+03	3.08E+05	1	0.00	1.12E+04
ICP.f.Mg	3.55E+02	7.31E+03	1	0.00	1.44E+03
ICP.f.Mn	6.28E+03	1.88E+04	1	4.54E+03	8.02E+03
ICP.f.Na	3.70E+04	6.00E+06	1	5.82E+03	6.81E+04
ICP.f.Ni	8.14E+03	6.41E+06	1	0.00	4.03E+04
ICP.f.P	1.04E+04	8.42E+05	1	0.00	2.21E+04
ICP.f.Pb★	3.65E+02	9.38E+03	1	0.00	1.60E+03
ICP.f.S	1.23E+03	1.13E+04	1	0.00	2.58E+03
ICP.f.Si	5.67E+03	5.41E+04	1	2.71E+03	8.62E+03
ICP.f.Sr	2.98E+02	6.24E+01	1	1.97E+02	3.98E+02
ICP.f.Ti	4.79E+01	6.09E+02	1	0.00	3.62E+02
ICP.f.Zn★	1.06E+02	7.17E+00	1	7.22E+01	1.40E+02
ICP.w.Al●	1.09E+01	5.75E+00	1	0.00	4.14E+01
ICP.w.Bi	2.02E+02	2.40E+03	1	0.00	8.24E+02
ICP.w.Ca★	6.16E+01	3.32E+01	1	0.00	1.35E+02
ICP.w.Cr	2.18E+02	2.45E+01	1	1.55E+02	2.81E+02
ICP.w.Fe	1.28E+02	3.11E+02	1	0.00	3.52E+02

Table 7-2. Concentration Estimate Statistics. (4 pages)
(Units μg/g Except Radionuclides μCi/g)

Analyte	$\bar{y}$	$\hat{\sigma}^2(\bar{y})$	df	95% LL	95% UL
ICP.w.K	7.19E+02	1.54E+03	1	2.21E+02	1.22E+03
ICP.w.La★	1.10E+01	1.42E+01	1	0.00	5.89E+01
ICP.w.Mg★	3.64E+00	5.45E-02	1	6.75E-01	6.61E+00
ICP.w.Mn	2.47E+01	2.36E+01	1	0.00	8.65E+01
ICP.w.Na	3.30E+04	2.44E+06	1	1.31E+04	5.28E+04
ICP.w.P	5.68E+03	3.24E+04	1	3.39E+03	7.97E+03
ICP.w.S	1.15E+03	2.38E+03	1	5.29E+02	1.77E+03
ICP.w.Si	5.72E+02	5.35E+03	1	0.00	1.50E+03
IC.w.Cl^-	4.50E+02	1.11E+03	1	2.56E+01	8.74E+02
IC.w.F^-	2.30E+03	6.46E+05	1	0.00	1.25E+04
IC.w.NO_2^-★	8.97E+02	2.10E+04	1	0.00	2.74E+03
IC.w.NO_3^-	4.12E+04	7.77E+06	1	5.82E+03	7.67E+04
IC.w.PO_4^{3-}	1.55E+04	1.53E+06	1	0.00	3.13E+04
IC.w.SO_4^{2-}	3.54E+03	2.85E+04	1	1.40E+03	5.69E+03
GEA.Am-241★	4.24E-02	2.61E-06	1	2.19E-02	6.29E-02
GEA.Co-60	3.64E-04	2.68E-10	1	1.56E-04	5.72E-04
GEA.Cs-137	1.66E-01	3.35E-03	1	0.00	9.02E-01
Gross.alpha	3.73E-01	1.96E-04	1	1.95E-01	5.51E-01
Gross.beta	1.51E+01	3.48E+01	1	0.00	9.00E+01
TGA.Percent.H_20	7.65E+01	2.23E+01	1	1.64E+01	1.37E+02
NO_2^-	7.93E+02	8.76E+03	1	0.00	1.98E+03
Percent.H_2O	7.60E+01	5.81E-01	1	6.63E+01	8.57E+01
Pu-239/240	1.39E-01	9.19E-06	1	1.00E-01	1.77E-01
Sr-90	5.41E+00	3.53E+00	1	0.00	2.93E+01
TOC★	3.12E+03	3.83E+05	1	0.00	1.10E+04
Tc-99●	7.92E-03	8.90E-06	1	0.00	4.58E-02

Table 7-2. Concentration Estimate Statistics. (4 pages)
(Units μg/g Except Radionuclides μCi/g)

Analyte	$\bar{y}$	$\hat{\sigma}^2(\bar{y})$	df	95% LL	95% UL
U★	2.79E+03	2.01E+05	1	0.00	8.50E+03
pH	9.98E+00	7.79E-03	1	8.86E+00	1.11E+01

●: Analytes with a portion of the data below 3 times the DL.
★: Analytes with a portion of the data below 10 times the DL.

7.3 COMPARISON OF THE VARIANCE COMPONENT ESTIMATES

Using the hierarchical structure of the core composite data, estimates of the between-core spatial variability, the compositing variability, and the analytical-measurement variability can be obtained. The spatial variance is a measure of the variability between cores. The compositing variance measures the variability between composite samples within the same core. The analytical-measurement variance is a measure of the difference between the analytical results from the sample and duplicate samples. This variance includes, among other things, the sample handling error and the chemical analysis error.

The estimate of the variance of the mean is a linear function of the spatial, compositing, and analytical-measurement variances. To help evaluate the magnitude of these three variance components, estimates of each variance component are given.

7.3.1 Statistical Methods

Estimates of the spatial variance ($\hat{\sigma}^2(S)$), compositing variance ($\hat{\sigma}^2(C)$), and analytical-measurement variance ($\hat{\sigma}^2(A)$), were obtained for each analyte using restricted maximum likelihood estimation methods. Restricted maximum likelihood estimation is discussed by Harville (1977).

To test the significance of the variance components, an analysis of variance (ANOVA) was calculated using the hierarchical statistical model described in Appendix B. The mean square error terms in the ANOVA table were used to perform an F-test on the spatial variability and the composite variability. The p-values given in Table 7-3 were derived from the results of these tests.

7.3.2 Statistical Results

The restricted maximum likelihood estimates of each component of variability along with the p-values (significance level) from the F-tests also are given in Table 7-3. P-values less than 0.05 indicate that $\sigma^2(S)$ or $\sigma^2(C)$ is significantly different from zero at the 0.05 significance level.

The p-values from the tests on $\sigma^2(S)$ were less than 0.05 for 40 out of the 79 analytes in tank 241-T-111 waste. Thus, for these 40 cases, differences between the results in the two cores were statistically significant**. The p-values from the tests on $\sigma^2(C)$ were less than 0.05 for 38 out of the 79 analytes in tank 241-T-111 waste. This indicates that, relative to the analytical error, differences between composite samples were significantly greater than zero in 38 cases. Conversely, for 41 out of 79 cases, differences between composite samples were not statistically significant. The number of analytes (and the amount that they contribute to the waste) for which $\sigma^2(S)$ and $\sigma^2(C)$ were statistically significant further suggests that the waste is heterogeneous.

7.4 MASS BALANCES

A method to help ensure the data are consistent and reasonable is to perform a mass and charge balance on the core composite sample data. This activity is a rough quality control check and provides insight to some of the properties of the matrix. To do this, the assumption in performing the mass balance is that the anions, cations, and water are all associated in some manner, but the exact chemistry of the association is not considered. Analytes contributing less than 0.2 weight percent, generally trace ICP analytes, AA analytes, and radionuclides, are considered negligible in this assessment. The assays that will contribute analytes to the mass balance are ICP acid or fusion (whichever gives higher quantitation), IC, TOC, and the gravimetric weight-percent water measurement.

Without considering the physical and chemical properties of the waste matrix and the context of the process history, the mass balances produced from these assays may be biased low. However, this bias is expected because it is known that there are analytes present that were not measured in the analysis of the samples. The IC anions only measure the water-soluble components; there is a substantial insoluble residue that must contain additional anions. Bias may be impacted substantially by chemical form, accountability, and variability in oxide or hydroxide content. Assumptions regarding the chemical combination of some of the analytes will be made and inserted into the mass/charge balance, presented in Table 7-4. Generally, this consists of assuming that some analytes are precipitated as an oxide or hydroxide, and that the shortfall indicated from the charge balance in microequivalent [μequ.] is present as one of those two analytes.

**Statistically significant for the purposes of this analysis means substantially greater than zero at the 0.05 level of significance.

Table 7-3. Variance Components Estimates. (3 pages)

Analyte	$\hat{\sigma}^2(S)$	Test: $\sigma^2(S)=0$ p-value	$\hat{\sigma}^2(C)$	Test: $\sigma^2(C)=0$ p-value	$\hat{\sigma}^2(A)$
ICP.a.Ag	1.56E+04	0.001	1.94E+02	0.000	3.16E+00
ICP.a.Al	1.89E+04	0.055	4.79E+03	0.000	1.06E+01
ICP.a.B	1.25E+01	0.093	9.28E-01	0.387	8.59E+00
ICP.a.Ba	6.91E+01	0.263	1.20E+02	0.000	3.54E-01
ICP.a.Bi	1.27E+07	0.000	6.25E+03	0.360	3.75E+04
ICP.a.Ca	4.10E+05	0.010	2.17E+04	0.074	9.95E+03
ICP.a.Cd★	5.96E+00	0.004	1.90E-01	0.039	5.34E-02
ICP.a.Co★	8.92E-01	0.376	8.08E-01	0.389	7.84E+00
ICP.a.Cr	3.17E+04	0.007	1.36E+03	0.081	6.75E+02
ICP.a.Cu	3.39E+02	0.290	1.67E+02	0.369	1.14E+03
ICP.a.Fe	2.33E+06	0.013	1.55E+05	0.063	6.25E+04
ICP.a.K	2.45E-24	0.911	8.86E+03	0.000	1.75E+02
ICP.a.La	5.91E+05	0.003	1.63E+04	0.019	2.88E+03
ICP.a.Mg	1.25E+04	0.005	5.18E+02	0.001	1.58E+01
ICP.a.Mn	2.97E+04	0.254	4.29E+04	0.030	1.00E+04
ICP.a.Na	2.76E+06	0.057	6.73E+05	0.016	1.05E+05
ICP.a.Ni	1.02E+03	0.000	6.13E+00	0.091	3.38E+00
ICP.a.P	2.37E-22	0.608	4.77E+05	0.000	1.25E+04
ICP.a.Pb	5.20E+04	0.003	1.41E+03	0.000	1.91E+01
ICP.a.S	1.11E+03	0.268	1.94E+03	0.003	1.25E+02
ICP.a.Si	2.57E-31	0.946	7.61E-14	0.418	7.34E+03
ICP.a.Sr	6.38E+02	0.079	2.18E+02	0.004	1.54E+01
ICP.a.Ti	2.75E+02	0.001	4.69E+00	0.000	7.83E-02
ICP.a.V	1.83E+00	0.423	2.25E+01	0.000	2.30E-01
ICP.a.Zn	1.22E+03	0.021	1.35E+02	0.008	1.42E+01
ICP.f.Ag	1.61E+04	0.000	6.23E+00	0.295	1.83E+01
ICP.f.Al	1.90E+04	0.005	6.78E+02	0.030	1.57E+02

Table 7-3. Variance Components Estimates. (3 pages)

Analyte	$\hat{\sigma}^2(S)$	Test: $\sigma^2(S)=0$ p-value	$\hat{\sigma}^2(C)$	Test: $\sigma^2(C)=0$ p-value	$\hat{\sigma}^2(A)$
ICP.f.Ba	3.99E+01	0.102	1.71E+01	0.012	2.19E+00
ICP.f.Bi	1.81E+07	0.001	2.88E+04	0.392	2.94E+05
ICP.f.Ca★	1.51E+05	0.008	2.07E-19	0.804	5.86E+04
ICP.f.Cd★	2.17E+00	0.126	1.21E-20	0.649	5.38E+00
ICP.f.Cr	3.72E-15	0.994	5.63E+03	0.013	1.21E+03
ICP.f.Cu★	6.97E+01	0.005	2.00E+00	0.119	1.43E+00
ICP.f.Fe	8.00E+06	0.003	1.68E+05	0.079	8.13E+04
ICP.f.La	5.96E+05	0.010	3.82E+04	0.012	4.98E+03
ICP.f.Mg	1.46E+04	0.000	5.15E-44	0.913	1.60E+02
ICP.f.Mn	1.66E-11	0.553	7.02E+04	0.011	9.70E+03
ICP.f.Na	1.17E+07	0.007	5.43E+05	0.044	1.65E+05
ICP.f.Ni	1.17E+07	0.033	4.18E-12	0.498	4.39E+06
ICP.f.P	1.57E+06	0.028	1.95E+05	0.049	6.45E+04
ICP.f.Pb★	1.85E+04	0.003	4.35E+02	0.030	1.02E+02
ICP.f.S	2.15E+04	0.017	2.00E+03	0.008	2.13E+02
ICP.f.Si	1.06E+05	0.005	1.00E+03	0.369	6.83E+03
ICP.f.Sr	6.12E-16	0.661	1.15E+02	0.222	2.69E+02
ICP.f.Ti	1.22E+03	0.000	2.66E-01	0.331	1.12E+00
ICP.f.Zn★	5.69E-23	0.440	1.10E-22	0.839	5.74E+01
ICP.w.Al●	7.35E+00	0.208	6.93E+00	0.061	2.72E+00
ICP.w.Bi	3.90E+03	0.102	1.30E+03	0.123	9.66E+02
ICP.w.Ca★	1.86E-11	0.144	1.69E-22	0.862	2.66E+02
ICP.w.Cr	5.66E-20	0.979	9.52E+01	0.001	5.62E+00
ICP.w.Fe	6.16E+01	0.436	9.05E+02	0.077	4.29E+02
ICP.w.K	2.28E+03	0.148	1.57E+03	0.001	4.73E+01
ICP.w.La★	2.71E+01	0.015	1.34E+00	0.226	2.23E+00
ICP.w.Mg★	3.04E-21	0.597	1.61E-01	0.098	1.14E-01

Table 7-3. Variance Components Estimates. (3 pages)

Analyte	$\hat{\sigma}^2(S)$	Test: $\sigma^2(S)=0$ p-value	$\hat{\sigma}^2(C)$	Test: $\sigma^2(C)=0$ p-value	$\hat{\sigma}^2(A)$
ICP.w.Mn	2.51E+01	0.266	3.19E+01	0.130	2.51E+01
ICP.w.Na	4.53E+06	0.030	6.84E+05	0.002	2.88E+04
ICP.w.P	3.98E+04	0.222	3.94E+04	0.089	2.13E+04
ICP.w.S	3.95E+03	0.091	1.50E+03	0.014	2.13E+02
ICP.w.Si	8.53E+03	0.113	1.98E+03	0.272	4.72E+03
IC.w.Cl	1.99E+03	0.043	1.15E-10	0.509	9.66E+02
IC.w.F^-	1.28E+06	0.001	1.37E+04	0.102	8.44E+03
IC.w.NO_2^-★	3.99E+04	0.015	5.22E-16	0.510	8.64E+03
IC.w.NO_3^-	1.42E+07	0.038	2.46E+06	0.013	3.44E+05
IC.w.PO_4^{3-}	2.59E+06	0.082	8.54E+05	0.030	1.99E+05
IC.w.SO_4^{2-}	5.27E+04	0.032	7.04E+03	0.071	3.14E+03
GEA.Am-241★	2.99E-32	0.786	8.13E-06	0.062	4.59E-06
GEA.Co-60	3.58E-10	0.046	5.14E-36	0.813	7.12E-10
GEA.Cs-137	6.61E-03	0.003	1.87E-04	0.000	1.88E-06
Gross.alpha	3.42E-04	0.065	7.74E-05	0.098	4.58E-05
Gross.beta	6.93E+01	0.000	3.14E-01	0.026	6.62E-02
TGA.%.H_20	3.17E+01	0.008	3.78E-33	0.935	5.18E+01
NO_2^-	1.92E-14	0.789	3.46E+04	0.000	9.50E+02
Percent H_2O	8.99E-01	0.128	2.55E-01	0.259	5.46E-01
Pu-239/240	2.49E-28	0.736	2.01E-05	0.171	3.33E-05
Sr-90	7.04E+00	0.000	1.79E-02	0.209	2.61E-02
TOC★	6.10E+05	0.113	2.98E+05	0.006	2.72E+04
Tc-99●	1.76E-05	0.001	2.63E-07	0.027	5.75E-08
U★	6.24E-06	0.831	7.91E+05	0.001	2.99E+04
pH	7.11E-28	0.601	3.06E-02	0.001	1.19E-03

●: Analytes with a portion of the data below 3 times the DL.
★: Analytes with a portion of the data below 10 times the DL.

Table 7-4. Core 31 and Core 33 Mass and Charge Balance. (2 pages)

Analyte	Core 31 average concentration (μg/g)	Core 31 charge (μequ/g)	Core 33 average Concentration (μg/g)	Core 33 charge (μequ/g)	Core 31/33 RPD
Ca^{+2}	2,710	135.50	2,140	107.00	23.51
Cr^{+3}	1,850	106.73	2,100	121.15	-12.66
Fe^{+2}	20,100	717.86	16,000	571.43	22.71
Mn^{+4}	6,160	448.00	6,400	465.45	-3.82
Na^{+}	39,400	1,713.04	34,600	1,504.35	12.97
Bi^{+3}	23,500	337.32	28,500	409.09	-19.23
La^{+3}	3,670	79.21	4,770	102.95	-26.07
Si^{+4}	5,900	842.86	5,440	777.14	8.11
U^{+6}	3,820	96.30	3,280	82.69	15.21
PO_4^{3-}	30,100	-950.53	31,700	-1001.05	-5.18
SO_4^{2-}	3,650	-76.04	3,460	-72.08	5.34
NO_3^{-}	44,100	-711.29	38,500	-620.97	13.56
F^{-}	3,110	-163.68	1,500	-78.95	69.85
TOC	3,740	-85.00	2,500	-56.82	39.74
Anion reconciliation					
O_2^{4-}	17,116	-2,139.50	16,926	-2,115.75	
OH^{-}	5,965	-350.88	3,325	-195.59	
Water content					
H_2O	735,000	0	790,000	0	-7.21
H_2O Calc.	785,109	0	798,859	0	-1.74

Table 7-4. Core 31 and Core 33 Mass and Charge Balance. (2 pages)

Analyte	Core 31 average concentration (μg/g)	Core 31 charge (μequ/g)	Core 33 average Concentration (μg/g)	Core 33 charge (μequ/g)	Core 31/33 RPD
Total	949,891	-0.10	991,141	0.05	
Percent difference*	-5.01		-0.89		

O_2^{4-}: Represents the overall mass and charge of oxygen added to manganese, uranium, silicon, TOC, and chromium as part of the assumptions given in Section 7.4. This notation is not meant to imply actual chemical form.
OH^-: Represents hydroxide amount calculated to reconcile charge balance
NOTE: Neither of these analytes (oxygen or OH^-) are analytically determined.

$$\text{Relative Percent Difference (RPD)} = \frac{\text{Core 31 value} - \text{Core 33 value}}{\left(\frac{\text{Core 33 value} + \text{Core 33 value}}{2}\right)} \times 100$$

*Percent difference is determined from a Total of $1.0E+06 \frac{\mu g}{g}$ i.e.,

$$\text{Percent Difference} = \frac{\text{sum of analytical values in a core} - 1{,}000{,}000}{1{,}000{,}000} \times 100$$

A significant source of error can be reduced by assuming all phosphorous is present as PO_4^{3-}. The water digestion ICP values for phosphorous (converted to PO_4^{3-}) and PO_4^{3-} values from the IC agree well. The ratio of soluble to insoluble phosphorous (taken as phosphate) indicates that it is only about 50 percent soluble. The process history of the tank also indicates that large amounts of phosphate were used to encourage precipitate formation. Therefore, an assumption that the phosphorus determined by ICP in the fusion acid/assay (and converted to phosphate) represents total PO_4^{3-} is not unwarranted. The phosphorus in the ICP fusion assay is converted to PO_4^{3-} and added to the other anions in the charge balance. This step will avoid double counting in the mass and charge balance calculations.

The following other assumptions will be made for the purposes of simplifying the calculations: manganese is assumed present as MnO_2, uranium is present as $UO_2(OH)_2$, silicon is present as SiO_3^-, TOC as $C_2O_4^{2-}$, and chromium as Cr_2O_3. These forms are not the

only likely speciation of the analytes; however, the waste matrices are too complicated to represent every possible, or even probable compound present.

In the case of these waste materials, the disparity between the gravimetric water measurement and the TGA water content suggests (1) drying of the sample before the gravimetric assay; (2) incomplete drying during the gravimetric test, which biases the results low; or (3) one or more endothermic events occurring in the same temperature range (chemical reactions or phase transitions resulting in the loss of mass). One or more of these factors may be responsible for the observed trend. However, in this case, the analytical results and chemical assumptions that were made with regard to the waste matrix reconcile well.

7.5 SUGGESTED COMPONENTS OF WASTE MATRIX

The actual composition of the waste matrix is quite complex and trace amounts of various compounds probably exist in the tank. However, with some simple assumptions regarding how the anions and cations will combine, a list of the most probable compounds that exist in the waste matrix and contribute significantly to its overall makeup can be developed.

Table 7-5 is a condensed version of a more general chart found on page D-147 in the *Handbook of Chemistry and Physics 64th Ed.* (Weast 1984). It provides solubility data on some of the most common anions and cations. The oxidation state shown in the table for the cations is the most stable. However, precipitates may form for multivalent cations under varying conditions, and so precipitates are reported as likely, if conditions and anions in the assessment of the analyst warrant it.

From the chromatographic data, suspected solubility behavior, and process information, chloride, nitrite, and carbonate will not be significant mass contributors to the waste matrix. Sodium, SO_4^{2-}, and NO_3^- are highly soluble, and thus probably do not contribute much to the insoluble solids. However, they contribute significantly to the overall solids content of the waste (dissolved + insoluble solids). Phosphorous is one of the most prevalent analytes, is approximately 50 percent soluble, and contributes substantially to both the soluble and insoluble solids. No analytical measurement of hydroxide was made for the solids (although there was an OH^- assay of the grab sample), but it is known that in the process history of tank 241-T-111, basic solutions were added routinely to the tank. The following are likely candidates for the insoluble solids:

- Bismuth phosphate, $BiPO_4$
- Bismuth hydroxide, $Bi(OH)_3$
- Calcium fluoride, CaF_2
- Bismuth fluoride, BiF_3
- Bismuth trioxide, Bi_2O_3
- Calcium phosphate, $Ca_3(PO_4)_2$

Table 7-5. Probable Solids in the Waste Matrix.

	NO_3^-	PO_4^{3-}	SO_4^{2-}	F^-	OH^-	Si (as SiO_2^{2-})	Oxide	CO_3^{2-}
Bi^{+3}		PPT		PPT	PPT		PPT	
Ca^{+2}		PPT	PPT	PPT		PPT	PPT	PPT
Cr^{+3}		PPT	PPT	PPT	PPT		PPT	
Fe^{+3}		PPT		PPT	PPT		PPT	PPT
Na^+								
La^{+3}			PPT	PPT	PPT		PPT	PPT
Mn^{+4}		PPT		PPT	PPT	PPT	PPT	PPT
U^{+6}	NL	PPT	PPT	NL	PPT		PPT	

PPT = Precipitate forms.
NL = Precipitate formation not likely under tank conditions.

- Calcium carbonate, $CaCO_3$
- Calcium oxide, CaO
- Calcium sulfate, $CaSO_4$
- Chromium(II) fluoride, CrF_2
- Chromium phosphate, $CrPO_4 \bullet 2H_2O$
- Chromium dioxide, CrO_2
- Chromium oxide, Cr_2O_3
- Iron(III) fluoride, FeF_3
- Iron(III) hydroxide, $Fe(OH)_3$
- Iron(III) phosphate, $FePO_4$
- Lanthanum oxide, La_2O_3
- Manganese diflouride, MnF_2
- Manganese phosphate, $MnPO_4 \bullet H_2O$
- Manganese dioxide, MnO_2
- Manganese(III) hydroxide, MnO(OH)
- Uranyl hydroxide, $UO_2(OH)_2$
- Calcium chromite, $CaCr_2O_4$
- Calcium silicate, $CaSiO_3$
- Calcium hydroxide, $Ca(OH)_2$
- Chromium(III) fluoride, CrF_3
- Chromium hydroxide, $Cr(OH)_2$
- Chromium monoxide, CrO
- Iron(II) fluoride, FeF_2
- Iron(II) hydroxide, $Fe(OH)_2$
- Iron(II) phosphate, $Fe_3(PO_4)_2$
- Lanthanum hydroxide, $La(OH)_3$
- Lanthanum fluoride, LaF_3
- Manganese triflouride, MnF_3
- Manganese hydroxide, $Mn(OH)_2$
- Manganese oxide, Mn_3O_4
- Uranyl phosphate, $UO_2HPO_4 \bullet 4H_2O$
- Uranyl sulfate, $2(UO_2SO_4) \bullet 7H_2O$.

Insoluble aluminosilicates are suspected of binding the ^{137}Cs. ^{90}Sr may be held by several possible insoluble ionic compounds. There are many more possible and complex compounds that conceivably could exist in the waste matrix. This list is not meant as authoritative or exhaustive, and the alkaline nature of the media may substantially alter the phase equilibria for some of these materials. However, it does provide a reasonable starting point for any further speciation work.

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8.0 CONCLUSIONS

Analyses of the waste show a very small number of analytes comprising a disproportionate majority of the waste. Water is the single largest analyte, making up over 75 percent of the solids mass. Less than one percent of the total mass of the tank waste is drainable liquid. Calcium, chromium, iron, manganese, sodium, lanthanum, bismuth, and silicon constitute approximately 10.7 percent of the solids mass. PO_4^{3-} and NO_3^- constitute approximately 7.4 percent of the total (i.e. soluble and insoluble) solids mass. The fraction of the total anions that nitrate and phosphate represent cannot be determined adequately because the analytical method measured only soluble anions and it is known that there are insoluble oxides and hydroxides that are not assayed at this time. The TOC was measured and found to be less than 1.3 weight percent (dry basis) in each core and for the tank as a whole. However, the TOC assay method is believed to biased low for this waste matrix and individual segment results have been observed to be higher than the bulk value for the tank.

The only significant gamma emitter found in the waste was ^{137}Cs, and it was found at very low levels. No meaningful regional concentrations (hot spots) of radioisotopes or fuel were detected along the vertical axis in either core. The ^{137}Cs concentration was relatively constant between individual core composites and their replicates; however, the concentrations between core 31 and core 33 differed by a factor of 2. In addition, the ^{137}Cs concentration decreased by a factor of nearly 3 as a function of depth between segment 1 and segment 9 of core 33. The major source of radiological activity was ^{90}Sr, which was also at a very low level. The bulk waste temperature in the tank, obtained from a thermocouple tree, ranges between 16 to 20 °C (61 to 68 °F). The radiological activity of tank 241-T-111 waste material was quite low, ranging from 0.3 to 10 mR/hr, measured through the drill string. No significant radiological activity was found in the drainable liquid in the tank or in the water digestion of the samples, but radionuclides were liberated readily in the acid digestion sample preparation, as indicated from the homogenization data. This suggests that ^{90}Sr and ^{137}Cs are insoluble.

Cores 31 and 33 appear to have a T-Plant process flush disposed on top of 224 waste, overlying a 2C waste heel. ^{241}Am and ^{137}Cs decrease substantially as a function of depth, thus their profiles nominally agree with fill histories, although individual batches and process upsets can show characteristics contrary to the general trend. These observations are consistent with the historical information regarding the transfer history, and the ICP element distribution through the segments. Discernable exothermic behavior was detected in the upper segments of both cores 31 and 33, even though the magnitude of the exotherms did not agree with the TOC present. This lack of an identifiable fuel source was attributed to the inability of the persulfate oxidation method to adequately quantitate TOC in this waste matrix. Another hypothesis under investigation is the potential contribution of an exothermic inorganic reaction that has not been identified.

Historical data indicated that 2C and 224 wastes were not expected to give any exothermic response at all, and could not create a propagating hazard. This prediction has been upheld

for 2C wastes as no exotherms were observed. In the 224 wastes, even though some small amounts of oxalate were indicated in the flowsheets, no reaction was expected. Calculations of the bulk waste inventory and inventories for several analytes of interest to the various safety issues [organics (as TOC), NO_3^-, ^{137}Cs, ^{90}Sr, plutonium, and water] were made. The calculated TOC by weight percent was smaller than the watch list criterion on a bulk basis, but the energetics results do not reconcile well with that interpretation, and indicate that the organic content in the tank may be disproportionately partitioned between the upper 100 cm of waste and the remainder of the tank. However, it is important to note that the organics concentration, even in this hypothesized enriched layer, may be too low to support a self-sustaining reaction in its present state. Reactions were observed only after all water had been removed from the waste matrix, and water makes up over 75 weight percent of the waste, providing an enormous heat sink to be overcome before reactions can be initiated. Both the historical and analytical data from tank 241-T-111 strongly indicate that the waste lacks the fuel concentration needed to sustain any propagating exothermic behavior or a heat source intense enough to trigger a reaction. None of the other calculated bulk inventory values exceeded any level of concern (see Table 8-1).

Experimental and analytical evidence from tank 241-T-111 waste suggests the risk from organic compounds in this particular Hanford-Site high-level waste tank is acceptable and that a propagating exothermic reaction under current and near-term tank operating conditions is not credible.

Table 8-1. Comparison of Tank 241-T-111 Analyte Values to Safety Issue Criteria.

Analyte	Safety issue criteria[1]	Calculated/ measured value
ΔH (dry basis)	-75 cal/g	In excess of -215 cal/g
$^{239/240}Pu$	50 kg	9.2 kg
Temperature	300 °F (149 °C)	16 °C (60.5 °F)
Heat load	11.72 kw	0.08 kw
Organic content (TOC, Dry basis) (10% sodium acetate equivalent)	3.0 wt% TOC	1.3 wt% TOC (This result is likely biased low)

[1](Lindsey 1986, RHO 1988, Boyles 1992, Reep 1992)

8.1 RECOMMENDATIONS

The following recommendations are made based on the data and analyses presented in this report and the goals of the characterization effort.

- Investigate the potential existence of alternate transfer paths from T-Plant.
- Examine more closely the chemical behavior, reactivity, and composition of Turco decontamination agent.
- Continue to characterize tank 241-T-111 sample matrices at PNL.
- Investigate the possible kinship between tank 241-T-111 and other tanks.
- Research and develop improved assay methods for TOC.
- Investigate observed discrepancy for alpha-emitting radionuclides (especially $^{239/240}Pu$ and U).

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Appendix A: Analytical Data

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Tank 241-T-111 Core 31 and Core 33 Introduction and Narrative

Introduction

The analyses in this data package were performed by the Westinghouse Hanford 222-S Laboratory or the Battelle Pacific Northwest Laboratory (PNL) under the guidance provided in the "Waste Characterization Plan for the Hanford Site Single Shell Tanks" (WHC-EP-0210) and the "Sampling and Analysis of Ten Single Shell Tanks" (WHC-SOW-91-0006). The quality control for single shell tanks is described in appendix D of WHC-EP-0210. Additional support data can be found in appendix I of WHC-EP-0210. Laboratory operations at 222-S are performed according to the "Quality Assurance Project Plan for the Analysis of Highly Radioactive Samples in Support of Environmental Activities on the Hanford Site" (WHC-SD-CP-QAPP-002) unless superseded by the waste characterization plan, appendix D, the associated SOW, or the Technical Project Plan (TPP).

Tank 241-T-111 (referred to as T-111 in the remainder of this package) is a single shell tank built in 1944 with an operating capacity of 500,000 gallons. T-111 received 488,000 gallons of "2C" and "224" type wastes through February 1976, and is classified as EHW (extremely hazardous waste). During early remediation efforts, ending in 1978, nearly 25,100 gallons of liquid was pumped out of T-111. The "2C" waste was from the second decontamination cycle of the bismuth phosphate process at the B and T plants. This waste consists of the liquid remaining after precipitation of the plutonium. The "224" waste was from the final decontamination and concentration stage of the bismuth phosphate process. In this stage, first the by-products and then the plutonium are precipitated with lanthanum fluoride. Historical data indicates the major components and estimated concentrations of these waste streams are as follows.

Component	224 (mol/L)	2C (mol/L)
Bi	0.0062	0.0092
Cr	0.0009	0.0025
F	0.31	0.22
Fe	--	0.023
oxalate	0.028	--
K	0.26	--
La	0.0014	--
Mn	0.0046	--
Na	1.75	2.04
nitrate	1.06	1.27
hydroxide	0.59	--
phosphate	0.049	--
Si	--	0.37
sulfate	--	0.62

Based on prior knowledge, cores from T-111 were expected to contain 8.5 segments. The first segment is normally the partial segment. Three cores were obtained from T-111 - cores 31, 32, and 33. Core 32 was not analyzed as the recovered material, all liquid, was considered not representative of the tank. No drainable liquids were recovered from cores 31 and 33. Drainable liquids are defined as quantities greater than 25 mL. Less than 25 mL quantities are blended back into the sample. Homogenization tests were performed on segments 1, 3, 5, 7 and 9 from core 33. Two composite samples were prepared for core 31 and core 33. Sample identification is obtained from the "sample point" section on the analytical card. A sample from core 31, segment 1 is designated "T111-C31-S1". Similarly, a sample from composite 1, core 33 is designated "T111-C33-C1", and a homogenization sample from core 33, segment 5 is designated "T111-C33-S5H".

All of the segments, with the exception of segment 9 of each core, were a homogeneous brown-black mud-like material. The bottom half of segment 9 had a white layer. The homogenization test for segment 9 used the entire segment (both phases) from core 33. Additional analysis (acid digest, water digest, ICP, GEA, TA and IC) were requested for the white layer on material from core 31. This sample is designated "T111-C31-S9B". All samples from T-111 exceeded the six month holding time limit.

Fifteen samples were sent to PNL. Volatile Organic Analysis (VOA) were requested on odd numbered segment samples for both cores and rheology on even numbered segment samples for core 31. The VOA requested for segment 9 is on the white phase only. Samples from both composites from each core were submitted for semi-VOA, Extractable Organic Halides (EOX), As, Se, Ni-63, Pu and U isotopic analyses. These samples and the requested analyses are as follows.

VOA:	core 31, segments 1, 3, 5, 7, 9.
	core 33, segments 1, 3, 5, 7, 9.
Semi-VOA, EOX, As, Se:	core 31, composites 1, 2.
	core 33, composites 1, 2.
Ni-63, Pu and U isotopic:	core 31, composites 1, 2.
	core 33, composites 1, 2.
VOA, semi-VOA:	hot cell blank.
	field blank.
Rheology & Physical:	core 31, segments 2, 4, 8.

The required QC is listed in table O-6 of appendix O, WHC-EP-0210. In summary, the requirements are:

- one laboratory control standard per analytical batch,
- one blank per analytical batch,
- one matrix spike per core or per matrix change,
- 100 % duplicates on all homogenization test samples and core composite samples,
- one duplicate per analytical batch for direct segment samples,

- a duplicate to verify each detected exotherm for DSC analysis.

The exceptions to the above guidelines are:

- % water is always ran in duplicate,
- Sr-90, Se-79, Tc-99, I-129, Pu and Am have a spike or carrier added to each sample, so no additional matrix spikes are required,
- GEA and pH do not require a spike,
- a matrix spike for Np is requested on each sample,
- ICP, HYAA, CVAA, and IC require additional, method specific QC. Instrument calibration and check standards are run according to specific procedure protocols.

Sample analysis are repeated at least once if the spike recovery is outside of 100 % ± 25 % (provided the spike concentration is at least 25 % of the sample concentration), or the duplicates have a relative % difference greater than 20 % (provided the analytical results are greater than 5 times the detection limit). If the original problem remains after one re-run, and the chemist has no explanation or "fix", additional re-runs are not required. These situations should be described in the "Analytical Batch Summary Sheet" described below. The entire batch does not have to be re-run unless the standard or blank for the batch failed.

A "Characterization Change Notice" was implemented during the T-111 analysis. The intent of the form is to document minor changes in analyses and deviations from the SOW or waste characterization plan. These are attached at the end of the summary section.

A "Chemist's Batch Summary Sheet" form was introduced for T-111 sample analysis and appears at the end of the analytical batch. Since this form was introduced after analysis started, one may not accompany each sample batch. The intent of this form is to document the chemist's initial data evaluation, and to provide a means of obtaining descriptive results from the chemist and chemical technologist on each sample batch. While not required as part of the final package, these forms will aid in preparing this narrative and provide insight into some of the problems encountered during sample analysis.

All analytical data for the package appears in a summary section. The summaries are lotus spread sheets intended to aid in review of analytical data, and may not include all of the associated laboratory control standards, dates, or laboratory identification numbers (J numbers). The spread sheet summaries display analytical results, blank data, detection limits, LMCS recoveries and spike recoveries, and using this data, calculates averages for duplicates, the relative percent difference between the duplicates, a mass and charge balance (described below), a ratio of the result to the detection limit, and various inter-comparisons throughout the summary. Secondary spread sheets are supplied that compare the core composite and homogenization duplicate and average results. Since a spike is not required for each sample, spike data is copied with each associated sample. "Less than" values are not used in any of the spread sheet calculations.

All analytical results are "wet weight" values, based on the actual extrusion weights. To convert to dry weight, divide the "weight wet value" by the weight fraction of solids (100 - %water / 100). All the preparation blanks and detection limits are reported in the same units as the sample results by assuming a typical sample size. This is done to provide a direct comparison of the background and degree of contamination present in the method to the sample results. Since the sample size is estimated, a "less than" value provided for a sample could be slightly lower than the given detection limit or blank value.

A charge balance is calculated for each core composite sample in the analytical summary. The charge balance is calculated by ratioing the equivalent charge of the cations to the anions. As an example, the equivalent charge of sulfate is calculated as follows:

$$\frac{\text{average ug/g sulfate}}{\text{milliequivalent weight of sulfate} * 1000}$$

Only the major components are used for these calculations, those with a concentration greater than 1000 ug/g. The cations used are Ca, Cr, Fe, Mn, K, Na, Bi, and La from the acid digested ICP results. The anions used are fluoride, nitrate, phosphate (calculated from the P on the acid digested ICP result), sulfate (calculated from the S on the acid digested ICP result), and acetate (calculated from the TOC results). The ratio ranges from 1.3 - 1.5. Proper incorporation of hydroxide would probably improve these ratios, since there is a relatively large uncertainty in the assumed molecular speciation model.

A mass balance is calculated for each core composite sample in the analytical summary, using an "oxide model" as the basis for the calculations for metals and the anions were present in their normal forms. The mass balance is the sum of the weight fractions of the major constituents (those with a concentration greater than 1000 ug/g). As an example, the weight fraction calculation for CaO is as follows:

$$\frac{\text{(ug/g of Ca} * \text{molecular weight of CaO)}}{\text{(atomic wt of Ca} * 1000000)}$$

The components used in calculating the mass balance are Bi, Ca, Cr, Fe, Mn, Na, U, F, nitrate, phosphate, sulfate, water, K, and La. It was assumed that all but K, Na, and F were present as oxides. The ratio ranged between 0.93 and 0.96.

SECTION I: EXTRUSION AND SAMPLE DATA

Visual

A summary of the extrusion data, entitled "Physical Properties Summary", is provided with the segment data. This is a compilation of all the recoveries for each segment of each core, with an associated percent recovery, penetrometer reading, and density. Photographs of the extruded segment are included in the data package. All volumes given that are less than 180 mL (100 % recovery) are estimates provided by the hot cell chemist. Segments marked with an asterisk on the summary sheet were recovered from sample

containers with the valves left in the "open" position (the waste was thick enough to remain in the container, even though the valve was not closed). The extrusion data for core 32 will be included in the core 31 package.

Core 31

Segment 1: The sampler was almost empty. It contained about 50 mL of homogeneous, black-brown, low viscous solids. The entire sample was used in VOA and DSC/TGA sampling. There was a tiny amount of liquid, not enough to observe characteristics.

Segment 2: The sampler was completely full of homogeneous, dark brown to black solids with the consistency of swamp mud. There were no drainable liquids.

Segment 3: The sampler was completely full of homogeneous, dark brown solids that had the consistency of swamp mud. There were no drainable liquids.

Segment 4: Most of the sampler was full of the same dark brown homogeneous solids. The top 1/8 of the extruder was filled with a more "liquidy" solids than the rest. There were no drainable liquids.

Segment 5: The sampler was completely full of the same dark brown homogeneous solids and contained no drainable liquids.

Segment 6: This sampler was empty, the valve was left in the open position.

Segment 7: The sampler was completely full of the same dark brown homogeneous solids and contained no drainable liquids.

Segment 8: The sampler was completely full of the same dark brown homogeneous solids and contained no drainable liquids.

Segment 9: The sampler was completely full of solids, the same dark brown solid material at the top, but gradually whitened down the segment. While the color varied, the consistency of the material was the same as all the other segments in this core.

Core 32

Segment 1: Contained about 50 mL (58.70 g) of "dark dishwater grey aqueous" liquid with about a 2 mm layer on the surface. There was a layer of bubbles covering the thin top layer, and adhering to the sides of the jar. No solids were collected.

Segment 2: Contained about 170 mL (88.35 g) of dark grey liquid with dark grey particles suspended in the liquid. There were only minimal solids (enough for a VOA sample) that had the consistency of loose mud or pudding and was dark brown/black in color.

Segment 3: Contained 180.90 grams of dark grey aqueous material. No solids were present. No volume was recorded.

Segment 4: Contained 182.48 grams of dark grey aqueous material. No solids were present. No volume was recorded.

Segment 5: Contained 191.05 grams of dark grey aqueous material. No solids were present. No volume was recorded.

Segment 6: Contained 185.52 grams of dark grey aqueous material. No solids were present. No volume was recorded.

Segment 7: The sampler was empty, the valve was left in the open position.

Segment 8: The sampler was empty, the valve was left in the open position.

Segment 9: Contained 158.24 grams of liquid, with about 150 mL of aqueous phase and 8 mL of NPH.

No samples were taken from core 32 as the material was judged to be non-representative of the material in the tank when compared to cores 31 and 33.

No photographs were taken for segments 1, 3, 4, 5, 6, 7, 8, 9.

Core 33

Segment 1: The sampler was completely full of nearly black homogeneous solids, and contained no drainable liquids.

Segment 2: The sampler was completely full of the same nearly black homogeneous solids, and contained no drainable liquids.

Segment 3: The sampler was completely full of the same nearly black homogeneous solids, and contained no drainable liquids.

Segment 4: The valve was left open on this core assembly. The extruder was about 75% full dark brown/nearly black homogeneous solids, and contained no drainable liquids. Color was slightly lighter than previous segment.

Segment 5: The valve was left open on this core assembly. The extruder was about 7/8 full of the same dark brown homogeneous solids, and contained no drainable liquids.

Segment 6: The sampler was nearly full of the same dark brown homogeneous solids, and contained no drainable liquids.

Segment 7: The sampler was nearly full of the same dark brown homogeneous solids, and contained no drainable liquids.

Segment 8: The sampler was nearly full of the same dark brown homogeneous solids, and contained no drainable liquids.

Segment 9: The sampler was completely full of solids, the same dark brown solid material at the top, but the bottom 5-6 inches was light colored. While the color varied, the consistency of the material was the same as all the other segments in this core. The segment

was divided into two parts, one was the bottom 5 inches of the segment which contained most of the white material. A VOA sample was taken from the top, and a DSC/TGA taken from the bottom. These samples were later combined for the homogenization test.

A field blank and a hot cell blank were also taken for T-111.

Sub-samples for T-111

The following numbers are the "J" numbers assigned as tracking numbers by the 222-S laboratory. The analytical batches may contain information from other sample numbers because of the way the samples were grouped for analysis. Results from other samples should be ignored, since they will be included in the data package for that specific segment.

	CORE 31	CORE 33	CORE 33 (Homog. Tests)
Segment 1	J308, J309	J319, J320	J396, J397, J398, J399
Segment 2	J310	J321, J323	NA
Segment 3	J311	J324	J400, J401, J402, J403
Segment 4	J312	J325	NA
Segment 5	J313, J315	J326, J327	J404, J405
Segment 6	none (empty)	J328, J329	NA
Segment 7	J315, J316	J330	J406, J407, J408, J409
Segment 8	J317	J331	NA
Segment 9	J318	J332, J333	J410, J411
Segment 98	J412, J413, J414	NA	NA

Core 31 composite 1	J415, J416, J417, J424, J425, J426, J432, J433, J438, J439, J440, J447, J448, J449, J455, J456, J457, J464, J465, J466, J472, J478, J479, J480, J493, J606, J607, J608, J609, J610, J611, J630, J631, J632, J641, J642, J643
Core 31 composite 2	J418, J419, J427, J434, J441, J450, J459, J467, J475, J485
Core 33 composite 1	J420, J421, J428, J429, J430, J435, J436, J442, J443, J445, J451, J452, J453, J460, J461, J462, J468, J469, J470, J476, J487, J488, J489
Core 33 composite 2	J422, J423, J431, J437, J446, J454, J463, J471, J477

Hot cell blank	J494, J495, J496, J498, J499, J500, J502, J503, J504, J506, J508, J513, J517

SECTION II: SEGMENT ANALYSIS

TGA

Thermogravimetric Analyses and Differential Scanning Calorimetry (DSC) are performed on every visible phase of the waste, prior to homogenization, to evaluate the thermal properties of the waste. The TGA results give a measure of the weight loss with increasing temperature. The result obtained from TGA is a weight % water. The TGA % water (percent weight loss at 100 degrees C) may vary considerably, due to a combination of the small sample size and sample heterogeneity. The procedure number for DSC, T042 A-01712F, has been changed to LA-514-113, Rev. A-0. The procedure number for TGA, T045 A-00712F, has been changed to LA-560-112, Rev. A-0. These procedures are routine Analytical Operations now, rather than Process Chemistry procedures.

The TGA results were 5-7% higher than the gravimetric wt % water, and ranged from 70-87%. Where duplicates were ran, there was good agreement, and results were consistent over all segment samples

% Water

More representative % water measurements are obtained with the gravimetric measurements, also reported in the summaries. Duplicate % water analysis were requested for all segment samples. However, the duplicates for segments 2, 3, 4, 5, 8, 9 from core 31 and segments 1, 3, 4, 5, 7, and 9 from core 33 were not requested until one month after the original samples were run. These latter values are added to the summary sheet, but due to the summary sheet format, the LMCS standard results are not included. The duplicate values for segments 2 and 4 from core 31 (32.60% and 59.60%) are probably low due to the sample drying out between analysis, or from a non-homogeneous "soupy sample" that would cause uneven sampling. There is no more sample for a re-run. However, the original sample results and the TGA agree quite well. There was no sample for a duplicate analysis of segment 8 from core 33.

DSC

DSC is used to identify the potential of exothermic reactions from the waste upon heating. In all cases, the identified exotherms were 3 to 4 times smaller than the detected endotherms. The calibration frequency of the instrument is determined by the chemist and is based on the instrument performance on laboratory standards.

Core 31: Exotherms were detected on the sample and duplicate for segments 1, 2, and 3. A very small exotherm, nearly an order of magnitude smaller, was detected for segment 4, and was not verified with a duplicate. No exotherms were detected for segments 5, 7, 8, 9, and 98 (the white layer). The temperature ranges for the exotherms were between 200 and 405 °C, with the energy around 300 J/g. The small exotherm had an energy of 55.7 J/g.

Core 33: Exotherms were detected on the sample and duplicate for segments 1 and 2, and only the sample for segment 3. The duplicate did not show an exotherm. The temperature ranges for the exotherms were from 179 to 438 °C,

with the energy around 300 J/g. The exotherm for segment 3 was small, about 50 J/g. No exotherms were detected for segments 4-9.

Particle Size

Particle size analyses are performed on every segment from every core to support the evaluation of potential waste retrieval methods. Small aliquots of the wastes were suspended in a water matrix using sonification before measuring the particle size by laser technology. The data are summarized in a table and four plots of probability number and probability volume density and distribution graphs. The procedure number for particle size analysis listed in the Technical Project Plan (WHC-SD-CP-TP-070, rev 0) is incorrect, and should be T044-A-01712F.

Penetrometer

Penetrometer readings are taken for each segment at extrusion. All of the segments were soft, with readings <100 psi.

Segment 9B (white layer)

In addition to the above analyses requested for each segment, ICP, IC, GEA, and TA were requested on the white portion of segment 9 of core 31. The sample was taken after the white layer had been homogenized. The ICP and TA resemble the homogenized segment data, and the IC resembles the core composite data. The spike recoveries for the ICP were biased low. There were no exotherms detected, and the % water was 70 %, about 5-10 % lower than the other segments.

General Comments

Because of the qualitative nature of TGA, DSC, particle size, and penetrometer analyses, no detection limits or precision and accuracy statements are required.

SECTION III: HOMOGENIZATION TEST ANALYSES

Introduction

Waste tank samples have a wide range of physical characteristics. Methods for homogenizing waste samples are limited by their applicability to hot cell operations and how well they lend themselves to remote operation and decontamination for reuse. Homogenization tests have been incorporated into the single shell tank characterization program to obtain estimates of the errors resulting from homogenization techniques employed during analysis. The evaluation of this data will support decisions made using the data and identify areas where homogenization procedures may be improved.

Homogenization Tests

Homogenization tests are performed on segments. After the segment has gone through the homogenization procedure, two sub-samples are taken from two different (top/bottom, left/right) locations in the homogenized segment. Each of the sub-samples are analyzed in duplicate to obtain estimates of the

analytical error. The differences in the results obtained on the two sub-samples will provide homogenization error. A statistical analysis (beyond the scope of this narrative) of the variance must be performed to differentiate between the analytical and homogenization errors. Each homogenization sample was analyzed by GEA, ICP, and TA on an acid digested sample. The acid digestion is the same as that used for normal ICP analysis.

Sub-samples

Homogenization tests were performed on segments 1, 3, 5, 7, and 9 from core 33. See the listing above for the J numbers assigned to the homogenization samples. The results are compiled in the summaries entitled "T-111 Homogenization Analyses" and "Homogenization Test Summary". One spike was considered sufficient for the homogenized sample data. A comparison of the RPD's of the duplicate results of each sample to the RPD of the averages of the two samples (see summary) shows virtually no difference for those elements well above their detection limits. This tank probably is not a good test of homogenization procedures, as the segment material was very uniform at extrusion. Even the white material in segment 9 was chemically similar to the rest of the segments, with the exception of segment 1. Segment 1 has much higher concentrations of Mn, Pb, Ag, and Zn when compared to the other segments, while Bi and La are much lower. The spike for the gross alpha on segment 5 was consistently high even after several re-runs.

SECTION IV: CORE COMPOSITE ANALYSES

Sample Preparation

Samples are prepared for core composite analyses using an acid and water digestion, and a KOH fusion. ICP and HYAA are run on the acid preparation, ICP, IC, nitrite by spectrophotometry, pH, ammonia, TOC, TIC, carbon-14, and tritium on the water digestion, and ICP and the other radiochemical analyses on the fusion preparation. The KOH fusion is contaminated with Ni from the crucibles used. LMCS standards for the acid digestion go through the sample preparation procedure. Standards for the water digestion and fusion are not run through the sample preparation procedures.

ICP

The ICP data is reported using a CLP software package from WARD Scientific Ltd (WARDS), and is used to generate the spread sheet summaries instead of the analytical cards. The calculations on the analytical cards are preliminary calculations performed by the instrument technician to access instrument operation and are not used in the final report.

WARDS utilizes the concept of a sample delivery group (SDG), and batches spike, duplicate, instrument control standards, blanks, serial dilutions, interference checks, and narrative information for each sample group. If the result is below the detection limit, the CLP report format will return a 200% RPD for duplicates and a 100% for serial dilutions. On all pages except the "duplicate" page (form VI-IN), any values less than the detection limit are replaced with the instrument detection limit, and should be interpreted as a "less than" value. The duplicate page (form VI-IN) reports what the instrument measures, and may include negative numbers. Since it is this page

that is used to generate the "result 1" and "result 2" columns in the summary sheets, negative values are included.

On the page in the WARDS package designated "COVER PAGE - IN", the answer to the third question, "...were raw data generated before application of background corrections?" has been changed to "no" based on the chemist's interpretation. This change does not affect the data or evaluation of the data in any of the WARDS packages generated in support of the SST program. The WARDS package Sample Delivery Group (SDG) number has a "/*" suffix, where the * is "N" for no sample preparation, "W" for water digestion, "F" for fusion, and "A" for acid digestion. This was not implemented until after analysis began on T-111, and so most of the WARDS packages will not have this identifier. The case narrative provided with each batch flags areas that would not meet CLP criteria. The WARDS package is configured to report all elements requested in the SOW except Tl, Th, and U, and report the additional elements B, Ce, La, P, Sr, S, and Ti. Form I-IN will not show negative results for individual determinations, while Form VI-IN does. The WARDS results used in compiling the master summaries are taken from the VI-IN form.

ICP analyses are ran on acid and water digests, and a KOH fusion. In the data summaries for the T-111 package, the preparation blank and the detection limit values for ICP have been converted from ug/L to ug/g by estimating the typical sample size and dilution involved in the preparation procedure. The acid and water blank and detection limit results (ug/L) were divided by a factor of 10 because the acid and water preparation procedures dissolve approximately 1 g of original sample in 100 mL of liquid. The fusion blank and detection limit results were divided by 2, as this preparation procedure dissolves approximately 0.5 g of sample in 250 mL of liquid.

The units for the "SA" column (spike added) on form V-IN are "mg/kg" for the pre-digestion spiked acid sample preparation, and "ug/L" for the post digestion spiked water and fusion sample preparations. Spike concentrations must be at least 25% of the sample concentration for proper evaluation.

Failure criteria for an entire WARDS package are under development. Since each ICP run generates results for 32 elements, there will always be some failures on each run. These failures are identified in the narrative associated with each WARDS package. Failure criteria should be based on the absolute failure rate of either spikes, duplicates, LMCS standards, and calibration standards, but tempered by the relative importance of the individual element that failed. For example, LMCS and spike recoveries may be generally high for Na, Ca, and Fe from contamination of the blank and sample during preparation, and Si and B from the use of glass containers during sample preparation. Spike or LMCS failures noted for these elements should not invalidate the entire WARDS package.

Several factors noted in the WARDS packages for T-111 create low spike recoveries and were noted by the ICP chemist. Silver recoveries are commonly low due to the precipitation of Silver Chloride. Poor recoveries of Iron, Magnesium, and Calcium accompany high Preparation Blank values, but the correlation is poor. Spike failures for major elements are frequently caused by a high element concentration in the sample. When the added spike concentration is insignificant compared to the concentration of the element present in the sample, a failure generally occurs.

The major elements detected by ICP analysis of the acid digestion were Ca, Cr, Fe, Mn, K, Na, Bi, La, P, and S (all greater than 1000 ug/g). Cr and Pb concentrations (1.86E+3 and 4.75E+2 ug/g respectively) would both exceed the 100 ug/g TCLP limit, assuming 100% leachability. The WARDS package performs inter-element corrections for Al, Ca, Fe, Mg, and Cr. Calcium and magnesium contamination often occurs as a result of the powder on the gloves used by laboratory personnel. The ICP analysis of the fused sample is used to evaluate the completeness of the acid digestion procedure, and to identify any acid insoluble compounds. The K results in the WARDS package often over ranges on the fusion, giving the impression that no K was in the sample. Ratios of the ICP results for major elements appear in the data summaries, and are used to estimate consistency and speciation. The fusion/acid ratio shows good agreement for Al, Fe, Na, P and Sr. Si and Ti are an order of magnitude higher in the fusion, while Bi is slightly higher in the acid digestions. Based on the ratio of the acid and water ICP data, about 10 % of the Cr is water soluble (CrVI). Most of the Na is soluble, but only 50 % of the phosphate, and essentially none of the Mn is soluble. There was no La reported for the water digested composite LMCS standard for core 33, and no Zr detection limits reported for the core composite samples. The Si results for ICP on all T-111 analyses are known to be biased low due to an undetermined interference.

CVAA and HYAA

Cold vapor atomic absorption (CVAA) was used for Hg analyses. The Hg results for T-111 ranged from 1.02-1.88 ug/g. The spike for core 31 was high (122%) and low for core 33 (82%). However, both were within the plus or minus 25% limits. All RPD's were less than 13%. Due to instrument and sample matrix problems, the As and Se elemental analyses were performed at PNL by graphite furnace AA.

Anion and Wet Chemical Analysis

Anions were determined on a water digestion of the sample. Ion chromatography (IC) was used to determine F, Cl, nitrate, nitrite, phosphate, and sulfate. All duplicates were within limits (<20 % RPD) and the results were consistent over all the composite samples. Post digestion spikes are used because of the high concentrations of the anions. Nitrate, phosphate, and F concentrations were high, consistent with the historical data available on T-111 waste. Spike recoveries were biased low for 3 of the 4 composite samples, but within the 75-125% limits. The S determined on the acid ICP, converted to sulfate, agrees very well with the sulfate determined by IC, while the same comparison of P with the phosphate shows the converted P a factor of 2 higher than the phosphate. This indicates that only 50 % of the phosphate is soluble. The pH is very consistent at about 10, while only "less than" values were obtained for ammonia. All the TIC results were near the detection limit, with good reproducibility and spike recoveries. TOC results were nearly an order of magnitude higher (2000-3000 ug/g). All analytical units were changed to ug/g for the data summaries, and may not agree with what is on the analytical card. All cyanide results obtained were "less than" values. Both the % water and TGA results were between 75 and 80 % with good precision over all the core composite samples.

Radiochemical Analysis

Most of the radionuclides are determined on the fusion due to the acid insolubility of actinide and Sr compounds. Tritium and C-14 are determined on the water digestion, and Ni-63 (analyzed at PNL laboratories) is determined on the acid digestion. There are indications that I-129 is lost during the acidification of the fused sample, which will require the development of an alternate digestion procedure for future work. In the cases where two spike recoveries are reported in the analytical summaries, one under the other, the spike recovery is used to correct for chemical yield. The second spike (bottom) corresponds to the duplicate result. Pu-238 is reported as part of the Pu-239 analysis, using the spike data from the Pu-239 procedure. Cm-244 would be reported only if seen on the Am-241 mount. The relative counting error reported is based on gross counts, and will under-estimate the counting error in those samples close to the detection limit (where the gross counts and the background counts are nearly the same). Calibration data for GEA labeled as detector "14" is data for detector "4".

During calibration updates, the new calibration file name for individual detectors have a "1" added (4 to 14) to avoid erasing the old calibration data prior to validation of the new calibration data. For T-111, the new calibration file name was not changed back to "4". Calibration of the alpha proportional counters (APC) is performed as follows. A standard source is prepared by the standards laboratory and used to calibrate one of the three detectors. Since the calibration standard is not durable enough for daily use, a secondary source is prepared and the d/m value of the secondary source is assigned using the calibrated detector. The secondary source is counted daily on all three APC's and tracked using the LMCS system. The detectors pass the daily check if the calculated efficiency for each detector is within 50% $\pm$ 0.25% (100% "recovery"). The LMCS data for the APC's and EDP codes are listed in the "Precision and Accuracy Statement" section.

Poor spike recoveries were obtained for uranium on core 33, but the data across all the core composite samples was consistent (between 2000-3000 ug/g).

Total alpha and total beta RPD's were normally under 5% with good recovery on the spikes. The total alpha results were twice the sum of the Pu and Am results, indicating 1) the potential presence of undetermined alpha emitters, 2) beta cross-talk (unlikely due to the beta activity present), or 3) incorrect Pu or Am recoveries (incomplete exchange with the spike). This last scenario is unlikely due to the consistency of the ratios, and the excellent agreement between the Am-241 results obtained by gamma spectroscopy and alpha spectroscopy. The ratio of the total beta to the sum of the Sr/Y and Cs-137 results show good agreement (.991 to 1.00) for the activity balance of the beta emitters. When sample "J-470" was rerun for poor spike recovery, a blank was not included in the analytical batch.

Sr-90 spike recoveries were consistently 90-95%. Results for core 31 were around 7 uCi/g while core 33 was around 3.5 uCi/g. These results vary more than the elemental Sr results from the fusion ICP, where the results are consistent across both cores (280-310 ug/g). Tc-99 results were low, within a factor of 5 of the detection limits but spike recoveries were adequate (67-74%). The results for Se-79, H-3, and C-14 were at or below detection limits, while spike recoveries ranged from 85-95%. No standard material is available

for Se-79. The tritium procedure LA-218-113 was changed to LA-218-114 for T-111 analysis. This procedure uses microdistillation columns in place of the normal glass distillation equipment.

The Pu spike recoveries ranged from 50% to 90%, while Am recoveries were poor, 10-20%. No Pu-238, Np-237 or Cm-244 were present above detection levels. Spike recoveries for Np-237 were consistently low at around 70%.

Am-241 and Cs-137 were the only isotopes that were consistently found at quantifiable concentrations by gamma spectroscopy. No spikes were requested for gamma spectroscopy. As stated above, the beta activity based on the Cs-137 results from gamma spectroscopy agreed with the gross beta determination, and the Am-241 results from gamma spectroscopy agreed with the alpha spectroscopy results for Am. I-129 results were all "less than" values, therefore no counting error could be determined. The preparation blank for I-129 for core 33 was invalid based on spike recovery, but was not re-run as all results were "less than" values. The spike recoveries ranged from 39% to 57%.

Physical Measurements

DSC, TGA, and weight % water was performed on each core composite. Exotherms were observed (in duplicate) for both composite samples from core 31, but no exotherms were observed for core 33. This is not surprising, as the exotherms were small on the segment analysis and were done prior to homogenization. TGA and % water results are in the same range as found on the segment samples, 75-85%, with the TGA results being consistently higher than the % water.

TCLP Results

A TCLP extraction was performed on the waste using a TCLP procedure scaled down a factor of 10 for radioactive samples. The matrix spike was added before the TCLP extract was preserved and acidified (per SW-846 procedure), recognizing that possible precipitation of the spike material could result in low spike recoveries. In order to meet the duplicate, spike, and blank requirements of appendix D, the following sampling and digestion scheme was used on T-111. Composite 1 and composite 2 from core 31, composite 1 from core 33, and a blank were run through the TCLP digestion procedure. The composite 1 TCLP digests from core 31 and core 33 were split into two sub-samples, and one sub-sample from each digestion was spiked with the TCLP metals. All sub-samples were acidified. Each sub-sample was acid digested in preparation for analysis, with the unspiked sub-samples from both cores again prepared in duplicate (split into two samples prior to acid digestion) to determine analytical error. The composite 2 and blank TCLP digests from above were acidified, acid digested and submitted for analysis (no spike or duplicate measurements).

The RPD's were high for As, Ba, and Pb, but these analytes were present in concentrations less than 6 times the detection limit. Cd was the only element with spike recoveries within acceptable limits (greater than 75 %). A comparison of spiking procedures is being performed on the next single shell tank (C-110). Cr and Se both exceeded the TCLP limit. Good agreement was obtained for those elements well above the detection limits.

Field Blank and Hot Cell Blank

Field blanks are prepared by filling a sample container in the field, shipping it to the labs with the samples, extruding in the hot cell and collecting as drainable liquids. The hot cell blank is a rinse of the extruder tray. The required analysis for these samples are ICP, GEA, HYAA (As, Se), CVAA (Hg), TA, TB, TOC, IC, and VOA and semi-VOA. The raw data for the field blank and the hot cell blank is included at the end of the core 31 data package. No duplicate samples or spikes were required on the blanks. The ICP was ran on direct sample, so no corrections were made on the preparation blanks or detection limits. The ICP LMCS standard did not include Sr. There was insufficient sample for duplicate ICP analysis for the hot cell blank.

Hot cell blank: The major constituents in the ICP analysis were Na at 5 ug/mL, B at 1.5 ug/mL and Si at 4.75 ug/mL. All the rest were less than 1 ug/mL. The balance of the analytes determined (F, Cl, NO2, NO3, SO4, PO4, As, Se, Hg, TOC, TA, TB, and GEA) were "less than" values.

Field blank: The major constituents in the ICP analysis for the field blank were similar to the hot cell blank. The Na was at 8.07 ug/mL, B at 1.76 ug/mL, and Si at 4.47 ug/mL. The rest of the constituents were less than 1 ug/mL. Results greater than the detection limits were obtained for F, NO3, and PO4 on the IC, TB, and Cs-137 on the GEA. These levels of contamination are insignificant when compared to the concentrations of these analytes in the T-111 samples.

Accuracy and Precision Statements

Accuracy and precision estimates for the procedures used in analyzing T-111 core samples were compiled from the 222-S Laboratory Measurement Control System (LMCS) data base over the period of April 1, 1992 through July 22, 1992 (the time period that the samples were ran in the laboratory). The average percent recovery and standard deviation for each analyte are determined from multiple analysis of standards containing those constituents. Each analyte and analytical system has a specific EDP code. A different EDP code is used for each parameter, instrument, method, or standard used in the system. When more than one EDP code is provided, then more than one analytical system was monitored. If no data was available for an EDP code for the time frame of interest, the historical values based on earlier data has been provided. In these cases, the number of measurements noted as "n" is recorded as "0". Historical data typically is based on 50 measurements.

No standard Se-79 material is available from commercial suppliers of isotopes for the preparation of a standard. The LMCS standard data for DSC only indicates that an exotherm is detected, and 100 % recovery is noted. The results do not reflect errors caused by sample matrices, or special sample preparation procedures used prior to applying some of the methods.

The accuracy and precision estimates for T-111 are as follows.

Method	Analyte	EDP	n	Average % Recovery	Relative Std. Dev.	Comments
ICP						
LA-505-151	Al	S102	46	96.7	4.9	
	Sb	S104	50	100.2	3.0	Historical
	As	S106	5	99.6	2.5	
	Ba	S108	35	96.9	2.6	
	Be	S110	50	102.3	3.2	
	Cd	S116	21	98.5	3.5	
	Ca	S118	42	96.5	3.5	
	Cr	S122	56	100.3	3.0	
	Co	S124	6	98.6	2.0	
	Cu	S126	18	96.5	1.8	
	Fe	S130	39	98.5	2.7	
	Pb	S134	35	98.3	4.7	
	Mg	S138	30	98.1	3.7	
	Mn	S140	33	95.0	2.8	
	Ni	S148	31	98.9	2.7	
	K	S152	37	99.3	2.9	
	Se	S156	5	100.1	4.9	
	Ag	S160	17	99.1	3.5	
	Na	S162	49	96.1	2.3	
	V	S182	12	98.9	1.4	
	Zn	S184	36	99.0	2.4	
	Bi	S112	23	100.1	4.7	
	B	S114	9	95.8	3.0	
	La	S132	14	103.2	3.0	
	P	S150	31	96.9	4.2	
	Si	S158	23	94.4	5.1	
	Sr	S164	24	96.3	2.2	
	S	S166	32	100.1	3.2	
	Sn	S174	9	97.1	4.6	
	Ti	S176	13	98.1	2.2	
	Zr	S186	9	101.4	3.8	
	Ce	S120	4	103.9	1.3	

Method	Analyte	EDP	n	Average % Recovery	Relative Std. Dev.	Comments
CVAA						
LA-325-102	Hg	R716	18	102.8	6.0	
IC						
LA-533-105	F	R974	18	101.4	5.9	
	Cl	R972	20	99.0	4.4	
	NO3	R978	22	96.8	3.9	
	NO2	R968	22	101.2	4.9	
	PO4	R976	18	97.5	3.7	
	SO4	R970	21	96.9	3.9	
SPEC						
LA-645-001	NO2	S215	88	99.6	4.0	
TOC/TIC						
LA-622-102	TOC	S223	74	103.8	3.6	
LA-344-105	CO3	S346				
Dist/SPEC						
LA-695-101	CN	S242	29	99.4	3.5	
LA-695-102		S244	9	99.5	2.0	
Dist/Titrate						
LA-634-102	NH3	S235	70	99.6	6.4	
		S236	70	99.6	6.4	
Fluorimeter						
LA-925-106	U	S267	111	100.8	8.2	
Alpha						
LA-508-101	Tot Alpha	S510	62	103.8	8.8	
LA-508-104	APC 1	C011	112	99.9	0.11	
	APC 2	C012	112	100.0	0.09	
	APC 3	C013	111	99.5	0.10	
LA-508-114	Det 14	C142	176	99.7	4.8	
	Det 16	C162	169	103.5	5.3	
Beta						
LA-508-101	Tot Beta	S515	59	98.3	4.4	
LA-508-114	Det 14	C143	176	99.0	3.1	
	Det 16	C163	170	99.7	7.4	
Gamma						
LA-548-121	GEA Cs-137	R901	28	101.9	2.4	
	Co-60	R905	28	100.6	2.3	
Alpha Spec						
LA-503-156	Pu-239	R211	20	99.0	5.3	
	Am-241	R201	31	94.2	8.2	

Method	Analyte	EDP	n	Average % Recovery	Relative Std. Dev.	Comment
Alpha						
LA-933-141	Np-237	S380	20	72.8	13.1	
Beta						
LA-220-101	Sr-90	S376	30	93.7	6.4	
LSC						
LA-438-101	Tc-99	S363	67	108.0	7.8	
LSC						
LA-365-132	Se-79	no standard material available				
Gamma						
LA-378-104	I-129	S928	16	107.8	9.1	
LSC						
LA-348-104	C-14	R909	26	91.6	7.3	
LSC						
LA-218-113	H-3	R907	10	84.7	4.4	
Gravimetric						
LA-564-101	% Water	S360	63	100.3	1.3	
Thermal						
LA-561-112	TGA	S362	6	98.8	1.4	
		R826	10	98.5	1.9	
Thermal						
LA-514-113	DSC	S230	16	100	0	
pH						
LA-212-103	H+	S348	4	100.6	0.15	

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From MW Urie MW Th

Subject GFAA (As, Se) Analytical Results for T111 (Core 31 & 33)

Graphite Furnace Atomic Absorption analyses were performed September 17 and 18 on the SST samples from Tank T111 Core 31 & 33 core composites following procedures PNL-ALO-214 (As) and PNL-ALO-215 (Se). The digestions were performed according to PNL-ALO-101 in the Shielded Analytical Laboratory and the analytical work was conducted in the Laboratory 303 using a P-E 5100 AA (WB76757). Results and all supporting data are archived in GFAA File: GF091792.

The ICV/CCV analytical control standards for As and Se analyzed between 99% and 108% recovery. The two pre-digestion blank spikes (or "process control standards") recoveries were 138% & 104% for As, and 57% & 58% for Se; the Se results are flagged with an "N" to indicate that the recoveries are less than 75%. The low control recovery on Se is indicative of a loss of Se during preparation; reanalysis was not performed due to lack of sufficient material. The results reported in the Summary Report may be bias low as much as 50% (i.e., if an adjustment is made for the control recovery, the Se results are 3.0 µg/g "U" instead of 1.5 µg/g "U"). The pre-digestion spiked samples for As recovered well (i.e., 95% & 83% at 5x dilutions), whereas the spiked samples for Se showed no recovery (i.e., at 10x dilutions) indicating a severe matrix interferance.

The results for the samples, duplicates, spikes and controls is presented in the attached GFAA Summary Report.

Concur: Arvid Bowman 9/23/92

GRAPHITE FURNACE AA ANALYSIS SUMMARY REPORT -- BANK 3111 CORE 31/33

			B1				B2				B3			B4		B5		
Analyte	Sample ID#	PNL Log#	Sample ug/g	Post Spike Rec	Flags C	Flags B	Dupl. ug/g	Post Spike Rec	Flags C	Flags B	B1&B2 RPD	Blank ug/g	Post Spike Rec	Flags C	Sample +Spike ug/g	Spike Rec	Spike True ug/L	Control Meas. ug/L	Rec
As	C31-comp1	92-08277	3.30	102%	U		3.30	100%	U		N/A	0.66	104%	U	4.67	95%	2496	3436	138%
Se	C31-comp1	92-08277	1.50	77%	U	M	1.50	82%	U		N/A	0.15	93%	U	<	N/A	2496	1432	57%
As	C31-comp2	92-08279	3.30	100%	U		3.30	101%	U		N/A								
Se	C31-comp2	92-08279	1.50	76%	U	M	1.50	72%	U		N/A								
As	C33-comp1	92-08281	3.30	97%	U		3.30	92%	U		N/A	0.66	111%	U	4.15	83%	2496	2601	104%
Se	C33-comp1	92-08281	1.50	80%	U	M	1.50	81%	U		N/A	0.15	78%	U	<	N/A	2496	1441	58%
As	C33-comp2	92-08284	3.30	96%	U		3.10	89%	U		N/A								
Se	C33-comp2	92-08284	1.50	64%	U	M	1.40	65%	U		N/A								

LKT
3.5.93

Notes
AA5100 PE (9/1/92): IDL >> As = 3.30 ug/L, Se = 0.75 ug/L; CRDL >> As = 10 ug/L, Se = 5 ug/L
Solids 8200x dilution: IDL >> As = 0.66 ug/g, Se = 0.15 ug/g; CRDL >> As = 2 ug/g, Se = 1 ug/g
The analytical spike is 20 ug/L for As and 10 ug/L for Se.
ICV/CCV used during analyses: As, Se -- ICP (ICV2(1290))
The pre-digestion spike is 25 ug/L for both As and Se.
Procedure: PNL-ALO-216 (As), PNL-ALO-215 (Se); NOTE: GFAA PE 5100 WB/6757

Flags
U = [Analyte] < IDL -- Note the value reported for the sample is the IDL.
B = IDL <= [Analyte] < CRDL
M = Pre-digestion Spike Recovery not within control limits (75-125%).
W = Post-digestion spike recovery not within control limits (50-150%).
* = RPD not within control limits.

•A

The relative percent difference (RPD) is calculated with sample 92-08290-H2 and its duplicate to indicate the overall analytical precision (3% for ^{63}Ni and 2% for ^{59}Ni).

A blank spike and matrix spike were prepared using ^{63}Ni; no NIST traceable ^{63}Ni was (or is) available for spiking purposes. The blank spike recovery is 95%. The matrix spike recovery is 91%. Thus the average batch bias is -7%.

A:\WP51\T111C313.RPT

-A

RADIOCHEMISTRY STANDARDS AND CONTROLS
Nickel-63 and Nickel-59
Supporting Documentation

This page indicates the location for supporting documentation for radiochemical analyses performed in support of $^{59\&63}Ni$ determinations.

Detector Controls

- LEPS detector background, control counts, and efficiency determination, see control and background files for M&TE # Diode A, Diode B, and Diode D.
- LSC detector background and control counts, see instrument log, Packard 2250XL, Lab 54, Bldg 325.

Solution standards:

- ^{63}Ni standard #54124-16-0, LRB 54124, page 16, Bldg. 329, room 10.
- Nickel (stable) carrier solution for yield determination, see LRB 53293, page 30.

Flourescence on the ^{59}Ni X-ray peak

- ALO office, 101SY $^{59\&63}Ni$ report

Performance checks of pipets and balances, see LRB 53647 pg. 83, 85, & 86 and LRB 54371, pg. 41.

cr34c112.sup

TABLE 13a: SST Core 31 & 33, Radiochemistry Data
Pu-238, Pu-239/240, Pu MS Isotopic.

Sample ID	*	TOTAL ALPHA PU uCi/g	+/- % error	Pu MS Isotopic Mass Percent Pu-238	Pu-239	Pu-240	Pu-241	Pu-242
Core 31 & 33	tank 111							
92-08278-M-1	f/smp	4.22E-01@	7	0.005	96.6924	3.2238	0.0373	0.0136
92-08278-M-2	f/dup	8.14E-01@	7	0.005	96.7474	3.1980	0.0331	0.0165
92-08278-M-3	f/blk	2.01E-04	20	**	**	**	**	**
92-08280-M-1	f/smp	7.81E-01@	7	0.016	96.5346	3.3470	0.0658	0.0369
92-08280-M-2	f/dup	3.46E-01@	7	0.005	96.7358	3.2197	0.0334	0.0061
92-08282-M-1	f/smp	2.08E-01	7	0.004	96.7470	3.0688	0.1275	0.0524
92-08282-M-2	f/dup	4.30E-01	7	0.004	96.7609	3.1403	0.0867	0.0841
92-08284-M-1	f/smp	2.09E-01	8	0.017	96.4481	3.4004	0.0848	0.0501
92-08284-M-2	f/dup	5.27E-01	7	0.004	96.6514	3.2866	0.0401	0.0172
BLANK (uCi/ml)		2.3 E-04						
STANDARD (% RECOVERY)		96						

* A = acid, f = fusion, W = water leach, smp = sample, dup = duplicate, blk = blank
** = not analyzed
@ average of two analyses

Battelle
Pacific Northwest Laboratories

-A

Project Number

Internal Distribution

L. R. Greenwood
File/LB

Date October 9, 1992

To Susan McKinley

From J. H. Kaye J. H. Kaye

Subject Analytical Results for Ni-59 and Ni-63 in Tank T111, Cores 31 and 33

Nine core composite samples were received from the hot cell for $^{59\&63}Ni$ analysis (92-08278-H1, -H2, -H3; 92-08280-H1, -H2; 92-08282-H1, -H2; and 92-08284-H1 and -H2). These represent fused composite samples and duplicates, and a fused hot cell blank from Tank T111, Cores 31 and 33. These samples were analyzed with their corresponding QC samples (two reagent blanks, a blank spike, a matrix spike, and a sample duplicate) according to procedures PNL-ALO-473, Revision-1, Nickel Separation from Radioactive Solutions, PNL-ALO-464, Procedure for Gamma Counting and Data Reduction in the Low-Level Counting Room, and PNL-ALO-474, Liquid Scintillation Counting.

Revision 1 of PNL-ALO-473 has been submitted to the ALO office. In this revised procedure, the option of 3 dimethylglyoxime precipitations was used. This was followed by anion exchange and the remainder of the procedure (steps 5.1 through 5.5, then steps 5.13 to end).

A summary of the results obtained is given in the attached table.

Chemical yields are determined by ICP measurement of stable Ni on an aliquot of the final solution prepared for LSC. The yield based on gravimetric means is determined but is not used for calculation of results. It is performed to determine if electroplating was successful. The error in the ICP measurements is quoted at ±15% relative; however ±5% is a better estimate of the error based on typical performance criteria with ICP analysis on ideal matrices such as presented with the samples submitted for analysis (2 volume percent nitric acid and no interfering ions). The data are therefore calculated with the error of ±5% applied to the ICP determination.

The fusion blank is used to monitor contamination due to hot cell operations; the reagent blanks are used to monitor contamination due to the laboratory analysis. The fusion blank and reagent blanks are calculated similarly to the composite fusion samples in order to provide a value which can be compared to the samples. The fusion blank gave a slightly positive result for ^{63}Ni, but this is insignificant compared to the sample results. A mean sample size of 0.5006 grams was used for the reagent blanks. A value of 60 ml was used for the sample volume analyzed for the reagent blanks, as this amount was used for seven out of the eleven sample volumes.

Detection limit estimates for the reagent blanks were approximately 4E-06 for both ^{63}Ni and ^{59}Ni.

Battelle
Pacific Northwest Laboratories

Project Number

Internal Distribution

File/LB

Date September 30, 1992

To SG McKinley

From CO Harvey

Subject Radiochemical Results for TIII (Core 31 & 33)

The radiochemical analyses were performed on four core composites, two each from Core 31 and 33. The solid core composite was prepared by potassium hydroxide (KOH) fusion, following procedure PNL-ALO-103. Duplicate samples and a single process blank were analyzed. The samples were analyzed for Total Alpha Plutonium, Uranium and for isotopic composition of the Pu and U. There was generally good agreement between duplicates for Uranium except for samples 92-08280-H1 and H2. However, the results were verified by re-analysis. The agreement of duplicates for Pu was poor, differing by a factor of approximately two. The duplicates for samples 92-08278 and 92-08280 were reanalyzed with good agreement with the original measurement, indicating acceptable analytical performance. The results of the individual analysis are included with the data. The average of the analyses is reported in the summary tables. The reason for the disagreement is unknown.

The Nickel-63 analysis are not complete and will be reported at a later date.

Concur: 9-30-92

Table 13b1 BST Core 31 & 33, Radiochemistry Data
U-lamer, U M3 Isotopic

		U-lamer	+/- 2	U M3 Isotopic Mass Percent			
Sample ID	*	mg/g	error	U-234	U-235	U-236	U-238
Core 31 & 33 Imm 111							
92-08270-M-1	f/amp	3.58	3	0.0045	0.6698	0.0062	99.3195
92-08270-M-2	f/dup	4.39	3	0.0122	0.6611	0.0115	99.2952
92-08270-M-3	f/blk	<1 E-01	np	np	np	np	np
92-08280-M-1	f/amp	7.028	4	0.0072	0.6760	0.0071	99.3097
92-08280-M-2	f/dup	3.108	4	0.0062	0.6762	0.0077	99.3099
92-08282-M-1	f/amp	4.74	4	0.0062	0.6817	0.0078	99.3051
92-08282-M-2	f/dup	4.16	4	0.0053	0.6705	0.0066	99.3196
92-08284-M-1	f/amp	3.30	3	0.0058	0.6646	0.0059	99.3219
92-08284-M-2	f/dup	3.47	4	0.0059	0.6720	0.0067	99.3103
Blank (uCi/ml)		<4 E-07					
Standard (% Recovery)		95.6					

* A = acid, f = fusion, W = water leach, amp = sample, dup = duplicate, blk = blank
** = not analyzed
# Average of two analyses

Nickel-63 and Nickel-59 Results, Tank T-111, Cores 31 and 33

ALO Sample ID	Sample Type	Ni-63 (microCi/g)	+/- one sigma*	RPD	Ni-59 (microCi/g)	+/- one sigma*	RPD
92-08278-111	Composite 1 fusion, Core 31	7.34E-03	4.0E-04		7.16E-05	1.9E-05	
92-08278-112	Composite 1 fusion, Core 31	1.13E-02	6.2E-04		9.43E-05	2.7E-05	
92-08278-113	Fusion Blank	6.17E-06	1.4E-06		<2E-06		
92-08280-111	Composite 2 fusion, Core 31	7.32E-03	4.0E-04		6.53E-05	1.8E-05	
92-08280-112	Composite 2 fusion, Core 31	3.62E-03	2.0E-04		3.30E-05	1.0E-05	
92-08280-112	Composite 2 fusion, Core 31 (duplicate)	3.53E-03	1.9E-04	3	3.36E-05	9.4E-06	2
92-08282-111	Composite 1 fusion, Core 33	6.36E-03	3.5E-04		4.74E-05	1.5E-05	
92-08282-112	Composite 1 fusion, Core 33	4.54E-03	2.5E-04		4.14E-05	1.2E-05	
92-08284-111	Composite 2 fusion, Core 33	4.26E-03	2.3E-04		3.76E-05	1.0E-05	
92-08284-112	Composite 2 fusion, Core 33	4.92E-03	2.7E-04		4.37E-05	1.2E-05	
	Reagent Blank 1**	<5E-06			<2E-06		
	Reagent Blank 2**	<6E-06			<5E-06		

	Added (dpm)	+/- one sigma*	Recovered (dpm)	+/- one sigma*	Recovery (percent)
Blank Spike (Ni-63)	776	12	735	40	95
Matrix Spike (Ni-63)	776	12	704	77	91

* One sigma uncertainties are based on propagation of mass, volume, counting, and yield determination uncertainties.

** Two reagent blanks were used for this batch of analyses. The results have been normalized relative to the sample volumes utilized.

Entered By J. M. Kaye Date 10/9/92

Reviewed By [signature] Date 10-8-92

ORGANIC COMPOUND ANALYSIS REPORT

SEMIVOLATILE COMPOUNDS

SAMPLE ANALYSIS REPORTED

Analysis of SST samples from Cores 31 and 33 Composites, Building 222S Hot Cell Blanks, and Field Blanks for semivolatile organic compounds by gas chromatography/mass spectrometry (GC/MS) is the subject of this report.

SAMPLE DESCRIPTION AND PREPARATION

Sample ID	ACL Lab Number
Core 31 Composite 1	92-08277
Core 31 Composite 2	92-08279
Core 33 Composite 1	92-08281
Core 33 Composite 2	92-08283
222S Hot Cell Blank	92-08285
Field Blank	92-08286

The samples were received on 07/30/92. Extractions of both samples and spiked samples were performed according to the following procedures.

- Extraction procedure: PNL-ALO-120 for the solids; PNL-ALO-122 for the water sample partitioning
- Extraction location: Analytical Chemistry Hot Cells and labs 306/308, 325 building
- Extraction type: Sonication, medium level soil for core samples; Separatory funnel, medium level water for 222S Hot Cell Blank and Field Blank samples
- Sample/Extract storage temperature: 4°C(+/-2°)

The procedure used to extract the matrix spiked core sample resulted in a two phase extract concentrate. The second phase was eliminated by adding approximately 20 mL methylene chloride to the extract concentrates, and mixing each of these solutions with 20 grams sodium sulfate for about 30 minutes.

ANALYSIS METHOD

- GC/MS procedure: PNL-ALO-345.
- GC/MS instrumentation: HP-5890/5970 GC/MS (WB38473)
- GC/MS location: Lab 325, 325 building.

T-111 Core 31 Direct Segment Analyses

Segment 1

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.309						
	DSC	EXOTHER	NA	EXOTHERM	EXOTHERM	NA	NA
	18.309						
	TGA	100.7	NA	87.0	86.9	87.0	0.12
	18.309						
% WATER		99.2	NA	80.8	79.8	80.3	1.23

Segment 2

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.310						
	DSC	EXOTHER	NA	EXOTHERM	EXOTHERM	NA	NA
	18.310						
	TGA	100.7	NA	87.0	NA	NA	NA
	18.310						
% WATER		99.2	NA	J 82.4	32.6	57.5	84.61

Segment 3

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.311						
	DSC	EXOTHER	NA	EXOTHERM	EXOTHERM	NA	NA
	18.311						
	TGA	100.7	NA	85.0	NA	NA	NA
	18.311						
% WATER		99.2	NA	82.2	97.5	89.8	16.82

T-111 Core 31 Direct Segment Analyses

Segment 4

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	10.312						
	DSC	EXOTHER	NA	EXOTHERM J		NA	NA
	10.312						
	TGA	100.7	NA	83.6	NA	NA	NA
	10.312						
% WATER		99.2	NA	J 77.3	39.6	58.5	25.86

Segment 5

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	10.313						
	DSC	EXOTHER	NA	NO EXO	NO EXO	NA	NA
	10.313						
	TGA	99.2	NA	88.0	NA	NA	NA
	10.313						
% WATER		99.2	NA	78.4	88.4	83.4	11.99

Segment 7

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	10.316						
	DSC	EXOTHER	NA	NO EXO	NO EXO	NA	NA
	10.316						
	TGA	99.3	NA	83.1	84.4	83.8	0.83
	10.316						
% WATER		100.7	NA	76.4	77.2	76.8	1.04

T-111 Core 31 Direct Segment Analyses

Segment 8

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.317						
	DSC	EXOTHER	NA	NO EXOTHER	NA	NA	NA
	18.317						
	TGA	99.3	NA	85.6	NA	NA	NA
	18.317						
% WATER		100.7	NA	76.2	76.4	76.6	0.39

Segment 9

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.338						
	DSC	EXOTHER	NA	NO EXO	NA	NA	NA
	18.338						
	TGA	99.3	NA	71.0	NA	NA	NA
	18.338						
% WATER		101.0	NA	76.9	74.7	75.8	2.90

Segment 9B

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.484						
	DSC	EXOTHER	NA	NO EXO	NO EXO	NA	NA
	18.484						
	TGA	97.8	NA	72.8	73.0	72.9	0.14
	18.484						
% WATER		99.9	NA	69.5	71.2	70.4	2.42

Special Analysis of Segment 9 (white layer)

	Analyte	LMCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio
SB-414		add (ug/L)	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/g)	% Rec	(ug/g)	B/DL
ICP-Acid	Al	5000	116 60	1 24E-01	J 1 48E+02	1 51E+02	1 50E+02	2.29	99.88	65.60	2 40E+00	62 41
	Sb	5000	97 90	3 11E-01	UJ -5 87E+00	-6 36E+00	-6 21E+00	-11.17	99.88	80 60	1 77E-01	-0.33
	As	5000	90 60	3 00E+00	UJ -4 23E+00	-7 55E+00	-5 89E+00	-56.40	99 88	77.60	3 00E+00	-1.96
	Ba	10000	64 50	3 00E-01	J 5 71E+02	5 65E+02	5 68E+02	0.98	199.76	80.20	3 00E-01	1892.47
	Be	10000	91 40	1 00E-01	UJ -1 27E-01	-7 46E-02	-1 01E-01	-51.76	199.76	88 80	1 00E-01	-1 01
	Cd	10000	93 00	4 00E-01	J 2 58E+00	2 47E+00	2 52E+00	4.36	199.76	89 60	4 00E-01	6 31
	Ca	10000	128 00	8 60E-01	J 8 95E+02	9 29E+02	9 12E+02	3.69	199.76	55.60	4 40E+00	207.31
	Cr	5000	98 70	9 00E-01	J 1 97E+03	1 99E+03	1 98E+03	0.76	99 88	34 80	9 00E-01	2201 84
	Co	10000	95 10	1 82E+00	UJ 3 91E+00	3 43E+00	3 67E+00	13.16	199.76	90.30	8 00E-01	4.58
	Cu	5000	94 60	8 04E-01	J 9 27E+00	9 03E+00	9 15E+00	2.63	99 88	89 50	4 00E 01	22 97
	Fe	5000	151 20	3 84E+00	J 1 52E+04	1 54E+04	1 53E+04	1.47	99.88	-203.9	1 00E+00	15274 6
	Pb	5000	90 20	6 20E+00	J 9 84E+01	9 85E+01	9 85E+01	0.11	99 88	84.70	6 20E+00	15 88
	Mg	5000	101 60	1 07E+01	J 2 25E+02	2 35E+02	2 30E+02	4.34	99.88	61.50	3 00E-01	767 33
	Mn	5000	92 20	2 00E-01	J 4 99E+03	5 04E+03	5 01E+03	1.00	99 88	-49	2 00E-01	25066
	Ni	5000	98 20	1 70E+00	J 8 92E+01	9 06E+01	8 99E+01	1.51	99.88	89.50	1 70E+00	52 89
	K	5000	94 60	1 12E+01	J 3 83E+02	4 02E+02	3 93E+02	4.71	99 88	99.10	1 12E+01	35 06
	Se	5000	98 20	7 60E+00	J -8 60E+01	-5 74E+01	-7 17E+01	-39.92	99 88	13 90	7 60E+00	-9 43
	Ag	5000	48 00	5 00E-01	UJ 1 14E+00	9 28E-01	1 03E+00	20 15	99 88	51.10	5 00E-01	2 06
	Na	10000	157 00	6 20E+01	J 4 01E+04	4 04E+04	4 02E+04	0.78	199.76	-366.1	3 10E+00	12971 23
	V	10000	94 90	3 00E-01	UJ 1 38E+00	1 52E+00	1 45E+00	9.44	199.76	92.20	3 00E-01	2 90
	Zn	10000	94 80	2 03E+00	J 2 10E+01	2 04E+01	2 07E+01	3.09	199.76	90.70	3 00E-01	69 04
	Bi	5000	66 20	7 50E+00	J 2 59E+04	2 60E+04	2 60E+04	0 26	99 88	-840 9	7 50E+00	3466 71
	B	5000	143 60	3 66E+00	J 3 66E+01	3 28E+01	3 47E+01	11 45	99 88	47 00	6 00E-01	31 13
	Ca	5000	104 00	1 01E+01	J 6 19E+01	6 09E+01	6 24E+01	4.76	99 88	92 60	1 01E+01	6 18
	La	5000	98 00	1 40E+00	J 4 36E+03	4 61E+03	4 58E+03	1.17	99 88	-13 90	1 40E+00	3273 70
	P	10000	94 10	5 80E+00	J 1 67E+04	1 69E+04	1 68E+04	1.17	199.76	-28 90	5 80E+00	2898 47
	Si	10000	226 80	2 17E+01	J 4 03E+02	4 18E+02	4 12E+02	3.31	199.76	596 20	1 30E+00	316 64
	Sr	10000	94 20	1 22E+00	J 4 17E+02	4 19E+02	4 18E+02	0.42	199.76	84.40	1 00E-01	1393 70
	S	5000	112 70	1 85E+01	J 1 47E+03	1 49E+03	1 48E+03	1.24	99 88	36 40	2 70E+00	546 98
	Sn	5000	91 20	2 50E+00	UJ 3 05E+00	3 00E+00	4 02E+00	48 63	99 88	88 80	1 60E+00	2 52
	Ti	5000	94 00	4 00E-01	J 4 48E+00	4 21E+00	4 35E+00	4.49	99 88	89 90	4 00E-01	10 88
	Zr	10000	88 30	8 00E-01	UJ -1 18E+01	-1 13E+01	-1 15E+01	-4.08	99 88	139 20	8 00E-01	-14 33

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T-111 Core 31 Direct Segment Analyses

Special Analysis of Segment 9 (white layer)

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spike	DET LIM	Ratio	
	18.414	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	% Rec	(ug/g)	S/DL	
IC-Water	F	107.00	<1.00E-01	J 4.77E-03	4.24E+03	4.51E+03	11.76	119.00	1.00E+01	450.50	
	Cl	96.10	<1.00E-01	J 9.43E-02	7.53E+02	8.48E+02	22.41	96.60	1.00E+01	84.80	
	NO3	93.90	<1.00E-02	J 6.12E-04	5.48E-04	5.80E-04	11.03	111.00	1.00E+02	580.00	
	NO2	101.00	<1.00E-02	J 8.42E-02	6.56E-02	7.49E-02	24.83	99.20	1.00E+02	7.49	
	PO4	96.50	<1.00E-02	J 2.68E+04	2.62E+04	2.73E+04	9.43	99.80	1.00E+03	273.00	
	SO4	96.00	<1.00E-02	J 5.31E-03	4.72E+03	5.13E-03	15.44	109.00	1.00E+02	51.33	
	P/PO4					1.67E+00					
	S/SO4					8.65E-01					
		Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spike	DET LIM	Ratio	S CNT ERR
	18.414	% Rec	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	%	% Rec	(uCi/g)	S/DL	
RAD-Pu	TA	104.60	<6.71E-4	1.53E-01	1.83E-01	1.68E-01	17.86	114.40	6.70E-04	250.75	2.30
	18.414										
GEA	Cs-137	103.00	<1.2E-3	1.03E-02	9.72E-03	1.00E-02	5.79	NA	7.50E-03	133.47	2.60
	Eu-154	NA	<2.22E-4	<2.48E-4	<2.22E-4	NA	NA	NA	2.40E-04	NA	
	Eu-155	NA	<1.52E-4	<2.16E-4	<1.69E-4	NA	NA	NA	1.19E-04	NA	
	Am-241	NA	<2.62E-4	2.80E-02	2.84E-02	2.84E-02	1.40	NA	2.28E-04	125.44	2.90
	Co-60	101.00	<8.43E-5	<8.72E-5	<7.64E-5	NA	NA	NA	8.15E-05	NA	

Hot Cell Blank

	Analyte	LABCS Std		FALF BLK	Blank #1	Blank #2	Average	RPD	Spk add	Spike	DET LIM	Ratio
Io 300		add (ug/L)	% Rec	(ug/L)	(ug/L)	(ug/L)	(ug/L)	%	(ug/g)	% Rec	(ug/L)	B/DL
ICP - Direct	Al	5000	93 80	2 40E-01	UJ 2 40E-01	none	NA	NA	NA	NA	2 40E-01	1 00
	Sb	5000	98 30	-1 37E-01	UJ 1 37E-01	none	NA	NA	NA	NA	1 37E-01	1 00
	As	5000	101 20	3 00E-01	UJ 3 00E-01	none	NA	NA	NA	NA	3 00E-01	1 00
	Ba	10000	101 20	3 00E-00	UJ 3 00E-00	none	NA	NA	NA	NA	3 00E-00	1 00
	Be	10000	99 40	1 18E-00	UJ 1 00E-00	none	NA	NA	NA	NA	1 00E-00	1 00
	Cd	10000	101 80	4 74E-00	UJ 4 00E-00	none	NA	NA	NA	NA	4 00E-00	1 00
	Ca	10000	93 30	4 40E-01	J 7 90E-02	none	NA	NA	NA	NA	4 40E-01	5 58
	Cs	5000	104 10	9 00E-00	UJ 9 00E-00	none	NA	NA	NA	NA	9 00E-00	1 00
	Co	10000	104 40	8 00E-00	UJ 8 00E-00	none	NA	NA	NA	NA	8 00E-00	1 00
	Cu	5000	100 40	4 00E-00	UJ 4 00E-00	none	NA	NA	NA	NA	4 00E-00	1 00
	Fe	5000	101 80	1 00E-01	J 1 24E-02	none	NA	NA	NA	NA	1 00E-01	8 40
	Pb	5000	104 10	6 20E-01	UJ 6 20E-01	none	NA	NA	NA	NA	6 20E-01	1 00
	Mg	5000	101 10	3 00E-00	J 1 91E-01	none	NA	NA	NA	NA	3 00E-00	1 00
	Mn	5000	100 30	2 00E-00	J 4 18E-01	none	NA	NA	NA	NA	2 00E-00	1 00
	Ni	5000	103 70	1 70E-01	UJ 1 70E-01	none	NA	NA	NA	NA	1 70E-01	1 00
	K	5000	109 60	1 12E-01	UJ 1 12E-01	none	NA	NA	NA	NA	1 12E-01	1 00
	Se	5000	101 20	7 60E-01	UJ 7 60E-01	none	NA	NA	NA	NA	7 60E-01	1 00
	Ag	5000	88 80	3 00E-00	UJ 3 00E-00	none	NA	NA	NA	NA	3 00E-00	1 00
	Na	10000	99 20	5 10E-01	J 4 93E-01	none	NA	NA	NA	NA	5 10E-01	9 61
	V	10000	101 80	5 00E-00	UJ 5 00E-00	none	NA	NA	NA	NA	5 00E-00	1 00
	Zn	10000	104 60	3 00E-00	J 3 62E-01	none	NA	NA	NA	NA	3 00E-00	8 31
	Bi	5000	104 30	7 50E-01	UJ 7 50E-01	none	NA	NA	NA	NA	7 50E-01	1 00
	B	5000	88 00	6 00E-00	J 1 44E-02	none	NA	NA	NA	NA	6 00E-00	240 00
	Ca	5000	101 10	1 01E-02	UJ 1 01E-02	none	NA	NA	NA	NA	1 01E-02	1 00
	La	5000	101 70	1 40E-01	UJ 1 40E-01	none	NA	NA	NA	NA	1 40E-01	1 00
	P	10000	92 40	5 80E-01	UJ 5 80E-01	none	NA	NA	NA	NA	5 80E-01	1 00
	Si	10000	73 20	2 27E-01	J 6 73E-03	none	NA	NA	NA	NA	1 30E-01	34 31
	Sr	--	--	1 00E-00	UJ 1 84E-01	none	NA	NA	NA	NA	1 00E-00	5 43
	S	5000	99 40	2 70E-01	J 2 40E-01	none	NA	NA	NA	NA	2 70E-01	8 89
	Sn	5000	102 80	1 80E-01	UJ 1 80E-01	none	NA	NA	NA	NA	1 80E-01	1 00
	Ti	5000	99 80	4 00E-00	UJ 4 00E-00	none	NA	NA	NA	NA	4 00E-00	1 00
	Zr	10000	93 80	8 00E-00	UJ 8 00E-00	none	NA	NA	NA	NA	8 00E-00	1 00

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T-111 Hot Cell Blank and Field Blank

Hot Cell Blank

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	
	18.517	% Rec	(ug/ml)	(ug/ml)	(ug/ml)	(ug/mL)	%	%	(ug/mL)	B/DL	
HYAA	As	98 60	<3 0E-4	UJ <3 50E-3	<3 50E-3	NA	NA	NA	<3 50E-3	NA	
	Se	108 00	<3 0E-4	UJ <3 50E-3	<3 50E-3	NA	NA	NA	<3 50E-3	NA	
CVAA	Hg	95 00	<3 0E-4	UJ <3 50E-3	<3 50E-3	NA	NA	NA	<3 50E-3	NA	
	18.504										
IC-Water	F	101 00	<1	UJ <1	<1	NA	NA	100	<1	NA	
	Cl	103 00	<1	UJ <1	<1	NA	NA	120	<1	NA	
	NO3	94 60	<1 0	UJ <1 0	<1 0	NA	NA	85 9	<1 0	NA	
	NO2	101 00	<1 0	UJ <1 0	<1 0	NA	NA	99 7	<1 0	NA	
	PO4	95 70	<1 0	UJ <1 0	<1 0	NA	NA	97 3	<1 0	NA	
	SO4	92 80	<1 0	UJ <1 0	<1 0	NA	NA	95 7	<1 0	NA	
	18.513										
TOC-Water	TOC	98 70	5 uQ C	UJ <3 5	<3 5	NA	NA	NA	500	NA	

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	Relative
	18.496	% Rec	(uCi/mL)	(uCi/mL)	(uCi/mL)	(uCi/mL)	%	%	(ug/mL)	B/DL	Count Err
RAD-Water	TA	101 90	<4 39E-6	<3 15E-6	<4 39E-6	NA	NA	NA	4 39E-06	NA	1 00E-01
	18.496										
	TB	100 10	9 38E-5	<7 23E-5	<7 96E-5	NA	NA	NA	9 38E-05	NA	6 60E-00
	18.496										
GEA	CS-137	101 00	<1 17E-6	<1 19E-6	<1 20E-6	NA	NA	NA	1 17E-06	NA	NA
	Eu-154	N/A	<2 87E-6	<3 07E-6	<3 96E-6	NA	NA	NA	2 87E-06	NA	NA
	Eu-155	N/A	<1 81E-6	<1 82E-6	<1 77E-6	NA	NA	NA	1 82E-06	NA	NA
	Am-241	N/A	<3 54E-6	<3 58E-6	<3 44E-6	NA	NA	NA	3 54E-06	NA	NA
	Co-60	101 00	<1 04E-6	<1 15E-6	<1 05E-6	NA	NA	NA	1 04E-06	NA	NA

T-111 Hot Cell Blank and Field Blank

Field Blank

Lab ID	Analyte	LMCS Std added (ug/L)	LMCS Std % Rec	PREP BLK (ug/L)	Result #1 (ug/L)	Result #2 (ug/L)	Average (ug/L)	RPD %	Spk add (ug/L)	Spike % Rec	DET LDL (ug/L)	Ratio B/DL
ICP-Acid	Al	5000	91 80	2 40E-01	J 3.67E-02	3 34E-02	3 42E-02	3 04	NA	NA	2 40E-01	14 23
	Sb	5000	98 30	-2 37E-01	UJ 1.77E-02	1.77E-02	1.77E-02	0 00	NA	NA	1.77E-02	1 00
	As	5000	101 20	3 00E-01	UJ 3 00E-01	3 00E-01	3 00E-01	0 00	NA	NA	3 00E-01	1 00
	Ba	10000	101 20	3 00E-00	UJ 4 62E-00	4.40E-00	4 56E-00	10.31	NA	NA	3 00E-00	1 83
	Be	10000	99 40	2 18E-00	UJ 1 00E-00	1 00E-00	1 00E-00	0 00	NA	NA	1 00E-00	1 00
	Cd	10000	103 90	4 34E-00	UJ 4 00E-00	4 51E-00	4 26E-00	12 89	NA	NA	4 00E-00	1 07
	Ca	10000	95 30	4 40E-01	J 7 80E-02	7.54E-02	7 67E-02	3 33	NA	NA	4 40E-01	5 44
	Cr	5000	108 10	9 00E-00	UJ 9 00E-00	9 00E-00	9 00E-00	0 00	NA	NA	9 00E-00	1 00
	Co	10000	104 60	8 00E-00	UJ 8 00E-00	8 00E-00	8 00E-00	0 00	NA	NA	8 00E-00	1 00
	Cu	5000	100 40	4 00E-00	UJ 5 32E-01	8.79E-00	5.10E-01	40 01	NA	NA	4 00E-00	
	Fe	5000	103 80	1 00E-01	UJ 1 00E-01	1 00E-01	1 00E-01	0 00	NA	NA	1 00E-01	
	Pb	5000	104 10	6 20E-01	UJ 6 20E-01	6 20E-01	6 20E-01	0 00	NA	NA	6 20E-01	
	Mg	5000	103 10	3 00E-00	J 7.75E-01	7.63E-01	7 69E-01	1 59	NA	NA	3 00E-00	
	Mn	5000	100 30	3 00E-00	J 5 07E-01	4 80E-01	4 94E-01	5 29	NA	NA	3 00E-00	
	Ni	5000	103 70	1 70E-01	UJ 1.70E-01	1.70E-01	1.70E-01	0 00	NA	NA	1.70E-01	
	K	5000	109 60	1 12E-02	UJ 1 12E-02	1 12E-02	1.12E-02	0 00	NA	NA	1 12E-02	
	Se	5000	101 20	7 60E-01	UJ 7.60E-01	7.60E-01	7 60E-01	0 00	NA	NA	7 60E-01	
	Ag	5000	80 80	5 00E-00	UJ 5 00E-00	5 00E-00	5 00E-00	0 00	NA	NA	5 00E-00	
	Na	10000	90 30	3 10E-01	J 8 30E-03	7.84E-03	8 07E-03	5 85	NA	NA	3 10E-01	2
	V	10000	101.00	5 00E-00	UJ 5 00E-00	5 00E-00	5 00E-00	0 00	NA	NA	5 00E-00	
	Zn	10000	104 60	3 00E-00	J 4.32E-01	4 17E-01	4 27E-01	4 64	NA	NA	3 00E-00	
	Bi	5000	106 30	7 50E-01	UJ 7.50E-01	7.50E-01	7.50E-01	0 00	NA	NA	7 50E-01	
	B	5000	88 00	6 00E-00	J 1 78E-03	1.73E-03	1 76E-03	3 23	NA	NA	6 00E-00	293 09
	Ce	5000	103 10	1 01E-01	UJ 1 01E-02	1 01E-02	1 01E-01	0 00	NA	NA	1 01E-02	1 00
	La	5000	102 70	1 40E-01	UJ 2 41E-01	2 16E-01	2 29E-01	11.78	NA	NA	1 40E-01	1 64
	P	10000	92 40	5 80E-01	J 8 18E-02	8 10E-02	8 14E-02	1 04	NA	NA	5 80E-01	14 03
	Si	10000	78 20	3 27E-01	J 4 61E-03	4.47E-03	4 54E-03	3 16	NA	NA	1 30E-01	349 44
	Sr	--	--	5 00E-00	J 3 71E-01	3 58E-01	3 65E-01	3 48	NA	NA	5 00E-00	73 16
	S	5000	99 40	3 70E-01	J 3 59E-02	3 48E-02	3 54E-02	4 50	NA	NA	3 70E-01	9 40
	Sn	5000	102 80	1 60E-01	UJ 1 60E-01	1 60E-01	1 60E-01	0 00	NA	NA	1 60E-01	1 00
	Ti	5000	99 90	4 00E-00	UJ 4 00E-00	4 00E-00	4 00E-00	0 00	NA	NA	4 00E-00	1 00
	Zr	10000	91 80	8 00E-00	UJ 8 00E-00	8 00E-00	8 00E-00	0 00	NA	NA	8 00E-00	1 00

T-111 Hot Cell Blank and Field Blank

Field Blank

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	
	18.518	% Rec	(ug/mL)	(ug/mL)	(ug/mL)	(ug/mL)	%	%	(ug/mL)	B/DL	
HYAA	As	98.60	<3.0E-4	UJ <3.50E-3	<3.50E-3	NA	NA	NA	<3.50E-3	NA	
	Se	108.00	<3.0E-4	UJ <3.50E-3	<3.50E-3	NA	NA	NA	<3.50E-3	NA	
CVAA	Hg	93.00	<3.0E-4	UJ <3.5E-3	<3.50E-3	NA	NA	NA	<3.50E-3	NA	
	18.505										
IC-Water	F	101.00	<.1	UJ 3.50E-01	3.30E-01	3.40E-01	3.88	1.00E+02	<.1	NA	
	Cl	103.00	<.1	UJ <.1	<.1	NA	NA	1.20E+02	<.1	NA	
	NO3	94.60	<1.0	UJ 4.30E+00	4.20E+00	NA	NA	8.99E+01	<1.0	NA	
	NO2	101.00	<1.0	UJ <1.0	<1.0	NA	NA	9.97E+01	<1.0	NA	
	PO4	95.70	<1.0	UJ 2.54E+00	2.45E+00	2.50E+00	3.61	9.73E+01	<1.0	NA	
	SO4	92.90	<1.0	UJ <1.0	<1.0	NA	NA	9.57E+01	<1.0	NA	
	18.512										
TOC-Water		98.70	5uG C	UJ <5.5	<5.5	NA	NA	NA	500	NA	
	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	Relative
	18.497	% Rec	(uCi/mL)	(uCi/mL)	(uCi/mL)	(uCi/mL)	%	%	(uCi/mL)	B/DL	Count Err
RAD-Water	TA	108.90	<4.39E-6	<4.39E-6	<5.15E-6	NA	NA	NA	4.39E-06	NA	70.70
	18.497										
	TB	100.10	<9.38E-5	1.16E-04	1.20E-04	1.18E-04	3.39	NA	9.38E-05	1.26	3.50
	18.497										
GEA	Cs-137	101.00	<1.17E-6	5.32E-05	5.44E-05	5.38E-05	2.50	NA	1.17E-06	47.78	3.60
	Eu-154	NA	<3.87E-6	<3.81E-6	<3.09E-6	NA	NA	NA	3.87E-06	NA	NA
	Eu-155	NA	<1.81E-6	<1.93E-6	<1.96E-6	NA	NA	NA	1.81E-06	NA	NA
	Am-241	NA	<3.54E-6	<3.72E-6	<3.71E-6	NA	NA	NA	3.54E-06	NA	NA
	Co-60	101.00	<1.04E-6	<1.07E-6	<1.11E-6	NA	NA	NA	1.04E-06	NA	NA

T-111 Core 31 Composite 1

	Analyte	LMCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LMd	Ratio	mcq	Matl
Id 449		add (ug/L)	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/g)	% Rec	(ug/g)	R/DL	lons	(g/
ICP-Acid	Al	1000	121.40	1.23E-01	J 5.88E-02	5.10E-02	5.49E-02	1.41	53.94	41.60	2.40E-00	245.31		
	Sb	1000	96.90	1.77E-01	UJ 2.19E-01	3.90E-01	3.04E-01	56.83	53.94	106.60	1.77E-01	3.72		
	As	1000	87.90	3.00E-00	UJ 3.17E-00	3.13E-00	3.15E-00	1.47	53.94	67.00	3.00E-00	1.03		
	Ba	2000	89.90	3.99E-01	J 5.73E-01	5.64E-01	5.70E-01	1.58	107.87	91.30	3.00E-01	190.14		
	Be	2000	84.40	1.00E-01	UJ 1.06E-01	1.04E-01	1.05E-01	1.48	107.87	84.40	1.00E-01	1.03		
	Cd	2000	87.80	-4.44E-01	UJ 7.25E-00	7.19E-00	7.22E-00	0.74	107.87	88.90	4.00E-01	18.03		
	Ca	2000	199.00	6.12E-01	J 3.26E-03	2.15E-03	2.20E-03	6.94	107.87	-48.40	4.40E-00	498.96	0.11	0
	Cr	1000	93.20	9.00E-01	J 1.89E-03	1.83E-03	1.86E-03	3.23	53.94	0.10	9.00E-01	2064.98	0.01	0.
	Co	2000	89.10	6.00E-01	UJ 3.38E-00	3.42E-00	3.40E-00	1.51	107.87	89.60	6.00E-01	6.25		
	Cu	1000	86.10	4.00E-01	J 2.57E-01	2.48E-01	2.52E-01	3.43	53.94	87.30	4.00E-01	63.13		
	Fe	1000	93.60	6.37E-00	J 1.95E-04	1.89E-04	1.92E-04	3.18	53.94	-630.6	1.10E-00	19316.3		
	Pb	1000	89.10	6.20E-00	J 4.81E-02	4.66E-02	4.73E-02	3.22	53.94	70.30	6.20E-00	26.34		
	Mg	1000	97.30	3.16E-00	J 4.36E-02	4.32E-02	4.35E-02	1.37	53.94	43.30	3.00E-01	1450.74		
	Mn	1000	94.60	2.00E-01	J 6.31E-03	6.07E-03	6.19E-03	3.76	53.94	-256.5	2.00E-01	30937.1		
	Ni	1000	89.70	1.70E-00	J 1.54E-02	1.49E-02	1.51E-02	3.61	53.94	84.50	1.70E-00	89.81		
	K	1000	105.80	3.62E-01	J 1.11E-03	1.08E-03	1.10E-03	2.24	53.94	58.70	3.62E-01	97.87		
	Se	1000	80.80	7.60E-00	UJ 8.04E-00	7.92E-00	7.98E-00	1.47	53.94	0.00	7.60E-00	1.05		
	Ag	1000	93.90	5.00E-01	J 2.03E-02	2.02E-02	2.03E-02	0.61	53.94	87.90	5.00E-01	405.26		
	Na	2000	133.00	3.10E-02	J 3.80E-04	3.71E-04	3.76E-04	2.42	107.87	-333.5	3.10E-00	12118.9	4.63	0
	V	2000	89.60	-3.31E-01	J 1.31E-01	1.23E-01	1.27E-01	5.62	107.87	90.40	5.00E-01	25.39		
	Zn	2000	86.20	9.19E-01	J 8.20E-01	7.68E-01	7.94E-01	6.57	107.87	88.30	5.00E-01	264.80		
	Bi	1000	56.40	7.50E-00	J 2.37E-04	2.34E-04	2.36E-04	1.27	53.94	-319.0	7.50E-00	3161.34		0
	B	1000	815.10	2.76E-01	UJ 3.06E-01	3.34E-01	3.21E-01	27.87	53.94	25.00	6.00E-01	45.25		
	Ca	1000	107.80	1.01E-01	UJ 3.33E-01	3.19E-01	3.26E-01	7.92	53.94	97.70	1.01E-01	3.23		
	La	1000	93.50	1.40E-00	J 3.78E-03	3.66E-03	3.72E-03	3.27	53.94	-38.40	1.40E-00	2657.03	0.00	0
	P	2000	82.60	9.58E-00	J 1.00E-04	1.02E-04	1.01E-04	1.99	107.87	493.40	5.80E-00	1748.84	0.01	0
	Si	2000	203.00	8.08E-01	J 4.36E-02	3.20E-02	4.03E-02	19.24	107.87	8.40	1.30E-00	370.84		
	Sr	2000	89.40	3.00E-01	J 2.85E-02	2.71E-02	2.82E-02	3.42	107.87	81.80	3.00E-01	938.96		
	S	1000	100.40	8.58E-00	J 1.24E-03	1.21E-03	1.23E-03	2.25	53.94	91.80	2.70E-00	454.66	0.11	0
	Sn	1000	94.30	3.66E-00	UJ 4.13E-00	4.30E-00	4.21E-00	3.33	53.94	89.40	1.60E-00	2.63		
	Ti	1000	89.80	4.00E-01	J 2.93E-01	2.96E-01	2.94E-01	1.06	53.94	83.50	4.00E-01	73.50		
	Zr	2000	88.10	8.00E-01	UJ 8.47E-01	8.34E-01	8.40E-01	1.48	107.87	8.60	--	NA		

T-111 Core 31 Composite 1

Direct/Uniform	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Batch	meq	Met Rel
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	B/DL	Lmo	(g/g)
	18.433											
	DSC	EXOTHER	NA	EXOTHERM	EXOTHERM	NA	NA	NA	NA	NA		
	3433			(E)	(E)	(E)						
	TOA	97.80	NA	LT 85.30	61.30	73.30	32.74	NA	NA	NA		
	18.416, 417			(E)	(E)	(E)						
S WATER	SWTR	99.70	NA	74.40	74.80	74.60	0.54	NA	NA	NA		0.746
	3436											
HYAA	As —	PNL										
	Se —	PNL										
CVAA	Hg	101.2	<0.125	LT 1.41E-00	1.70E-00	1.56E-00	33.84	123.00	0.125	12.72		
	18.440											
CN-Dis	CN	99.90	<5.0	<4.0 UJ	<4.5	NA	NA	68.10	5.0	NA	0.000	0
	CuNiFeCN6					NA						

T-111 Core 31 Composite 1

	Analyte	LMCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio
18 457		added	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/L)	% Rec	(ug/g)	R/DL
ICP-Water	Al	5000	93 60	2 40E-00	UJ 6 43E-00	6 99E-00	6 71E-00	8 53	1250	99 50	2 40E-00	2 80
	Sb	5000	91 40	1 77E-01	UJ 1 77E-01	1 77E-01	1 77E-01	0 10	1250	74 10	1 77E-01	1 00
	As	5000	92 40	3 00E-00	UJ 3 00E-00	3 00E-00	3 00E-00	0 10	2500	44 20	3 00E-00	1 00
	Ba	10000	98 30	3 00E-01	UJ 3 00E-01	3 09E-01	3 05E-01	3 03	2500	98 80	3 00E-01	1 02
	Be	10000	96 90	1 00E-01	UJ 9 99E-02	1 00E-01	1 00E-01	0 10	2500	98 60	1 00E-01	1 00
	Cd	10000	97 90	4 00E-01	UJ 4 00E-01	4 00E-01	4 00E-01	0 10	2500	97 20	4 00E-01	1 00
	Ca	10000	90 70	2 30E+01	UJ 5 12E+01	5 05E+01	5 08E+01	1 33	2500	91 00	4 40E-00	11 55
	Cr	5000	100 60	9 00E-01	J 2 07E-02	2 11E-02	2 09E-02	2 25	1250	98 80	9 00E-01	232 21
	Co	10000	96 40	8 00E-01	UJ 7 99E-01	8 00E-01	8 00E-01	0 10	2500	97 60	8 00E-01	1 00
	Cu	5000	95 80	4 00E-01	UJ 4 00E-01	4 00E-01	4 00E-01	0 10	1250	96 90	4 00E-01	1 00
	Fe	5000	97 00	1 00E-00	J 1 02E-02	5 70E-01	7 96E-01	56 97	1250	94 70	1 00E-00	79 63
	Pb	5000	94 00	6 20E-00	UJ 6 19E-00	7 91E-00	7 05E-00	24 34	1250	93 20	6 20E-00	1 14
	Mg	5000	98 70	6 60E-01	UJ 3 22E-00	2 67E-00	2 94E-00	18 77	1250	99 70	3 00E-01	9 81
	Mn	5000	93 80	3 00E-01	J 1 93E-01	1 01E-01	1 47E-01	62 70	1250	93 70	2 00E-01	73 45
	Ni	5000	97 30	1 70E-00	UJ 1 70E-00	1 70E-00	1 70E-00	0 10	1250	98 10	1 70E-00	1 00
	K	5000	103 10	1 12E-01	J 7 28E-02	7 40E-02	7 34E-02	1 65	1250	83 10	1 12E-01	65 53
	Se	5000	93 90	7 60E-00	UJ 7 59E-00	7 60E-00	7 60E-00	0 10	1250	101 80	7 60E-00	1 00
	Ag	5000	101 00	3 00E-01	UJ 4 99E-01	7 79E-01	6 39E-01	43 78	1250	102 50	3 00E-01	1 26
	Na	10000	96 40	2 88E-01	J 3 39E-04	3 41E-04	3 40E-04	0 49	2500	-27 70	3 10E-00	10973 7
	V	10000	95 30	3 00E-01	UJ 4 99E-01	5 00E-01	5 00E-01	0 10	2500	97 60	3 00E-01	1 00
	Zn	10000	97 90	-1 49E+00	UJ 5 00E-01	5 00E-01	5 00E-01	0 10	2500	97 00	3 00E-01	1 00
	Bi	5000	99 60	7 50E-00	J 1 47E-02	8 34E-01	1 15E-02	55 50	1250	59 90	7 50E-00	33 39
	B	5000	87 80	6 00E-01	J 3 11E-00	3 50E-00	3 31E-00	11 84	1250	86 10	6 00E-01	5 51
	Ce	5000	99 00	1 01E-01	UJ 1 01E-01	1 01E-01	1 01E-01	0 10	1250	99 30	1 01E-01	1 00
	La	5000	99 10	1 40E-00	J 7 01E-00	5 00E-00	6 02E-00	33 05	1250	100 50	1 40E-00	4 30
	P	10000	93 40	5 80E-00	J 5 89E-01	5 61E-01	5 76E-01	4 63	2500	82 90	5 80E-00	993 56
	Si	10000	80 00	1 30E+00	J 5 30E-02	5 43E-02	4 86E-02	42 46	2500	99 10	1 30E-00	336 55
	Sr	10000	97 80	3 00E-01	UJ 1 48E-00	9 34E-01	1 21E-00	45 14	2500	99 00	3 00E-01	4 03
	S	5000	97 10	2 70E-00	J 1 18E-03	1 31E-03	1 19E-03	2 13	1250	93 70	2 70E-00	441 49
	Sn	5000	92 70	1 60E-00	UJ 1 60E-00	1 60E-00	1 60E-00	0 10	1250	93 60	1 60E-00	1 00
	Ti	5000	97 80	4 00E-01	UJ 4 00E-01	4 00E-01	4 00E-01	0 10	1250	99 40	4 00E-01	1 00
	Zr	10000	98 30	8 00E-01	UJ 7 99E-01	8 00E-01	8 00E-01	0 10	--	--	--	

T-111 Core 31 Composite 1

	Analyte	Std Rec	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	meq	Wet Wt
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	B/DL	Ions	(g/g)
	38457											
IC-Water	F	94.50	<1.00E+1	J 3.01E-03	3.14E-03	3.09E-03	3.57	117.00	1.00E-01	308.50	0.16	0.00
	Cl	103.0	<1.00E+1	J 4.66E-02	4.73E-02	4.70E-02	1.49	119.00	1.00E-01	46.95		0.00
	NO3	93.20	<1.00E+2	J 4.41E-04	4.45E-04	4.43E-04	0.90	101.00	1.00E-02	443.00	0.71	0.00
	NO2	90.10	<1.00E+2	UJ <1.00E3	<1.00E3	NA	NA	104.50	1.00E+02	NA		0.00
	PO4	96.50	<1.00E+2	J 1.67E-04	1.56E-04	1.61E-04	6.81	88.00	1.00E-03	161.50		0.00
	SO4	90.70	<1.00E+2	J 3.69E-03	3.69E-03	3.69E-03	0.00	81.70	1.00E-02	36.90		0.01
	F ACID ICT/PO4 IC					1.72E+00						
	S ACID ICT/SO4 IC					9.97E-01						
	38457											
Spec-water	NO2	100.0	<5.00E+1	J 0.15E-03	0.49E+01	0.51E+01	0.61	97.30	5.00E-01	10.04		0.00
	NO3 (IC)/NO3 Spec.					44.10						
	NO3 (IC)/NO3 (SPEC)					0.00						
	38457											
pH	pH	100.7	NA	J 10.17	10.10	10.10	0.20	NA	NA	NA		
	38457											
NH3-Water	NH3	97.60	<4500	<4500 UJ	<4500	NA	NA	98.40	4.50E-03	NA		
	38457											
TOC-Water	TOC	98.50	<650	J 3.68E-03	3.30E-03	3.49E-03	10.89	93.80	5.00E-02	6.98		
	Acetate Eq		3.72E-04								0.291	0.000
	38457											
TIC-water	CO3	103.3	<500	UJ 6.30E-02	<5.00E+2	NA	NA	103.50	5.00E-02	NA	0.000	0.000

T-111 Core 31 Composite 1

	Analyte	LMCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio	meq	Mas
14466		added	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/g)	% Rec	(ug/g)	R/DL	Ions	(g)
ICP-Fusion	Al	5000	93.30	1.20E-01	J 6.56E-01	6.33E-02	6.44E-02	3.74	1250	94.20	1.20E-01	53.70		
	Sb	5000	90.70	8.83E-01	UJ 8.83E-01	8.87E-01	8.84E-01	0.20	1250	101.00	8.33E-01	1.04		
	As	5000	91.30	1.50E-01	UJ 1.50E-01	1.50E-01	1.50E-01	0.20	2500	44.00	1.50E-01	1.00		
	Ba	10000	97.00	1.50E-00	J 6.04E-01	5.72E-01	5.88E-01	5.34	2500	98.00	1.50E-00	39.21		
	Be	10000	99.80	1.15E-00	UJ 5.00E-01	5.01E-01	5.01E-01	0.20	2500	99.70	5.00E-01	1.00		
	Cd	10000	99.60	2.00E-00	UJ 9.16E-00	7.34E-00	8.25E-00	22.11	2500	100.40	2.00E+00	4.13		
	Ca	10000	92.40	1.38E-02	J 2.93E-03	2.58E-03	2.76E-03	13.70	2500	84.80	2.30E-01	125.39		
	Cr	5000	103.30	4.50E-00	J 1.92E-03	1.84E-03	1.88E-03	3.91	1250	106.00	4.50E-00	420.02		
	Co	10000	99.10	4.00E-00	UJ 1.01E-01	9.70E-00	1.01E-01	7.68	2500	99.60	4.00E+00	3.52		
	Cu	5000	93.60	3.33E-00	J 3.39E-01	3.68E-01	3.63E-01	2.64	1250	96.30	2.00E+00	18.17		
	Fe	5000	97.80	7.13E-01	J 2.01E-04	2.03E-04	2.05E-04	2.88	1250	123.50	5.00E-00	4103.72		
	Pb	5000	91.70	3.10E-01	J 4.33E-02	4.27E-02	4.40E-02	5.76	1250	88.90	3.10E-01	14.19		
	Mg	5000	99.50	1.36E-01	J 4.32E-02	4.24E-02	4.38E-02	6.32	1250	100.90	1.50E-00	292.00		
	Mn	5000	94.60	5.04E-00	J 6.47E-03	6.29E-03	6.38E-03	2.83	1250	103.20	1.00E-00	6381.58		
	Ni	5000	94.80	3.91E-01	J 5.61E-03	5.94E-03	5.77E-03	5.64	1250	107.00	8.50E-00	679.30		
	K	5000	100.10	5.60E-01	UJ 5.60E-01	5.61E-01	5.61E-01	0.20	1250	1344.3	5.60E-01	1.00		
	Se	5000	93.20	3.80E-01	UJ 3.80E-01	3.81E-01	3.80E-01	0.20	1250	96.60	3.80E-01	1.00		
	Ag	5000	100.80	8.50E-00	J 2.10E-02	2.10E-02	2.14E-02	3.59	1250	103.10	2.50E-00	85.74		
	Na	10000	93.00	4.69E-01	J 4.01E-04	3.96E-04	3.98E-04	3.28	2500	109.80	1.33E-01	2569.99		
	V	10000	98.20	2.50E-00	J 1.32E-01	1.11E-01	1.21E-01	17.23	2500	99.90	2.50E-00	4.85		
	Zn	10000	99.60	-1.36E-01	J 1.11E-02	9.71E-01	1.04E-02	13.00	2500	99.80	1.50E-00	69.22		
	Bi	5000	94.40	3.75E-01	J 2.14E-04	2.01E-04	2.09E-04	6.47	1250	78.40	3.75E-01	538.23		
	B	5000	83.10	3.00E-00	UJ 3.00E-00	3.01E-00	3.00E-00	0.20	1250	83.10	3.00E+00	1.00		
	Ca	5000	101.30	5.05E-01	UJ 5.05E-01	5.06E-01	5.06E-01	0.20	1250	97.80	5.01E-01	1.00		
	La	5000	99.50	7.00E-00	J 3.75E-03	3.63E-03	3.69E-03	3.26	1250	103.40	7.00E-00	527.61		
	P	10000	101.90	3.90E-01	J 1.19E-04	1.12E-04	1.16E-04	5.67	2500	103.70	2.90E-01	398.76		
	Si	10000	73.10	6.70E-01	J 6.04E-03	5.88E-03	5.96E-03	2.75	2500	79.10	6.50E-00	917.29	0.43	
	Sr	10000	97.30	1.30E-00	J 2.94E-02	2.86E-02	2.90E-02	3.38	2500	98.90	1.30E+00	202.19		
	S	5000	101.00	2.77E-01	J 1.36E-03	1.35E-03	1.35E-03	0.87	1250	102.60	1.33E-01	100.28		
	Sn	5000	93.00	8.16E-00	UJ 8.00E-00	8.02E-00	8.01E-00	0.20	1250	93.80	8.00E-00	1.00		
	Ti	5000	96.80	2.00E-00	J 7.25E-01	7.32E-01	7.29E-01	0.96	1250	97.80	2.00E-00	36.43		
	Zr	10000	93.20	4.00E-00	UJ 4.00E-00	4.01E-00	4.00E-00	0.20	1250	--	--	--		

WHC-EP-0806

WHC-SD-WM-DP-024 ADDENDUM 2, REV 0

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T-111 Core 31 Composite 1

			Water ICP/Acid ICP		Water ICP/Fusion ICP		Fusion ICP/Acid ICP	
			Ca	0.11	Al	0.010	Al	1.10
Charge Bal	Tot Cat	3.67	Mn	0.00	Ca	0.111	Fe	1.07
	Tot An	3.69	Si	1.55	Fe	0.004	Na	1.06
	Cat/An	1.06	S	0.97	Mn	0.002	Ni	0.89
			Na	0.91	Ni	0.006	Si	12.57
Material Balance: oxide model		0.93	Al	0.01	P	0.098	Ti	2.48
			K	0.67	Si	0.073	P	1.14
			P	0.37	Sr	0.004	Sr	1.08

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	meq	Mat Bal
		S Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	R/DL	Conc	(g/g)
	18.466											
Fusion	U	104.6	<3.51E-3	J 2.21E-03	2.14E-03	2.18E-03	3.23	104.60	2.50E-03	0.70	0.018	0.002
	U as uCi/g					7.24E-04						
	Analyte	Std #1	Prep Blk	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	Rel.	
		S Rec	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	%	%	(uCi/g)	R/DL	Ca Exs	
	18.466											
RAD-Fus.	TA	103.9	<3.14E-3	J 3.38E-01	3.39E-01	3.38E-01	0.26	101.10	7.50E-03	50.49	3.10	
	TA/Eu+Am					2.00E+00						
	18.466											
	TB	96.10	<9.33-3	3.07E+01	3.04E+01	3.06E+01	1.46	76.20	9.35E-02	219.79	1.20	
	TB/Cs+Sr					9.96E+01						
	18.466											
GEA	Cs-137	101.00	7.80E-04	3.11E-01	3.12E-01	3.11E-01	0.47	NA	3.70E-04	571.62	1.10	
	Eu-154	NA	<9.7E-4	1.07E-03	1.09E-03	1.08E-03	NA	NA	1.20E-03	0.90	NA	
	Eu-155	NA	<4.13E-4	<3.09E-3	<3.08E-3	NA	NA	NA	3.05E-04	0.00	NA	
	Am-241	NA	<1.17E-3	4.80E-02	4.37E-02	4.59E-02	9.38	NA	1.14E-03	40.22	0.50	
	Co-60	99.00	<3.56E-4	<3.39E-4	<4.21E-4	NA	NA	NA	4.07E-04	NA		
	18.466											
	PU239/40	98.00	<3.60E-3	J 1.41E-01	1.35E-01	1.38E-01	4.33	78.90	3.60E-03	38.33	1.00	
	PU-238	81.80	<3.60E-3	<1.07E-3	<1.04E-3	NA	NA	81.10	1.00E-03	NA	0.20	

T-111 Core 31 Composite 1

	Analyte	Std #1 % Rec	Prep Blk (uCi/g)	Result #1 (uCi/g)	Result #2 (uCi/g)	Average (uCi/g)	RPD %	Spk Rec %	DET LIM (uCi/g)	Ratio R/DL	Rel Ct Err
	10 466										
	Am-241	100 3	<3 70E-3	J 3 85E-02	4 43E-02	4.14E-02	14 01	22.50	3.70E-03	7.26	6 10
								17.80			8 80
	Cm-244			ounce detected		NA	NA			NA	
		Am-241 (OEA)/Am-241 (ALPHA)				3 11E-00					
	J 0446										
	NP-237	70 30	<4 49E-3	UJ <3 24E-2	<3 35E-2	NA	NA	73 60	3 42E-02	NA	3 30
	10 466										
	TC-99	118 3	<8 48E-4	3 33E-03	4 05E-03	3.14E-03	7.39	71.80	8.50E-04	6 05	4 50
								72.90			
	10 466										
	I-129	119 3	<1 60E-2	UJ <1 72E-2	<1 74E-2	NA	NA	57.40	1.72E-02	NA	
								51.10			

T-111 Core 31 Composite 1

	Analyte	Std #1	Prep Blk	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	Rel.	
		% Rec	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	%	%	(uCi/g)	B/DL	Ck Est	
	ID 466											
	Sr-90	88 60	< 40E-3	J 7 34E-00	6 97E-00	7 16E-00	5 17	92 00	7 10E-03	1007 7	0 30	
								91 80				
	ID 457											
	H-3	85 90	< 15E-4	< 15E-4 UJ	< 15E-4	NA	NA	81 30	3 15E-04	NA	6 60	
	ID 457											
	C-14	93 30	< 25E-4	< 25E-4 UJ	3 80E-04	NA	NA	93 70	2 25E-04	NA	4 50	
	ID 1466											
	Se-79	none	< 6 78E-5	UA < 6 11E-5	< 6 03E-5	NA	NA	89 10	5 63E-05	NA	4 50	
								93 60				

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	B/DL	TCLP LIM	Result/Lim
		% Rec	(mg/L)	(mg/L)	(mg/L)	(mg/L)	%	%	(mg/L)		(mg/L)	
	ID 441											
TCLP-ICP	Ag	99 40	3 00E-03	J 4 11E-03	3 50E-02	3 31E-02	48 71	2 90	3 00E-03	6 61	5 00	0 01
	Ba	97 80	3 00E-03	J 2 73E-01	1 50E-01	2 12E-01	58 16	3 40	3 00E-03	7 05	100 00	0 00
	Cd	97 00	4 00E-03	J 2 00E-02	2 00E-02	2 00E-02	0 00	94 10	4 00E-03	5 00	1 00	0 02
	Cr	101 30	9 00E-03	J 8 69E-00	8 52E-00	8 60E-00	1 97	50 30	9 00E-03	955 78	5 00	1 72
	Pb	98 50	6 70E-03	J 3 91E-01	3 11E-01	3 51E-01	22 74	8 70	6 20E-02	5 66	5 00	0 07
	As	95 50	3 00E-03	J 1 50E-01	1 50E-01	1 50E-01	0 00	--	3 00E-03	5 00	5 00	0 03
	Se	123 10	1 11E-01	J 1 21E-00	1 34E-00	1 27E-00	10 51	--	7 60E-02	16 77	1 00	1 27
	ID 632											
TCLP-CVAA	Hg	97 50	< 0 0100	UJ 4 50E-02	4 50E-02	4 50E-02	0 00	100 10	1 00E-02	4 50	0 02	2 25

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T-111 Core 31 Composite 2

	Analyte	LMCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio	meth	Lab
16450		std (ug/L)	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/g)	% Rec	(ug/g)	R/DL	flags	
ICP-Acid	Al	1000	121 40	1 23E-01	J 7 07E-03	7 03E-03	7 05E-03	0 38	53 94	41 60	2 40E-00	293 59		
	Sb	1000	94 50	1 77E-01	UJ 3 69E-01	3 61E-01	3 65E-01	2 30	53 94	106 00	1 77E-01	3 06		
	As	1000	81 90	3 00E-00	UJ 2 81E-00	3 03E-00	2 92E-00	7 19	53 94	67 00	3 00E-00	0 97		
	Ba	2000	89 90	3 99E-01	J 6 46E-01	6 33E-01	6 40E-01	1 86	107 87	91 70	3 00E-01	216 47		
	Be	2000	84 40	1 00E-01	UJ 9 38E-02	1 01E-01	9 73E-02	7 19	107 87	84 40	1 00E-01	0 97		
	Cd	2000	87 80	-4 44E-01	J 7 94E-00	7 78E-00	7 86E-00	2 03	107 87	88 90	4 00E-01	19 64		
	Ca	2000	139 00	6 13E-01	J 2 61E-03	2 56E-03	2 48E-03	10 34	107 87	-44 00	4 40E-00	564 67	0 12	
	Cr	1000	93 20	9 00E-01	J 1 84E-03	1 84E-03	1 84E-03	0 20	53 94	9 10	9 00E-01	2046 67		
	Co	2000	89 10	8 00E-01	J 8 17E-01	7 78E-00	7 76E-00	101 28	107 87	89 60	8 00E-01	9 70		
	Cu	1000	88 10	4 00E-01	J 9 17E-01	1 37E-02	7 96E-01	120 34	53 94	89 30	4 00E-01	199 06		
	Fe	1000	93 60	6 37E-00	J 2 00E-04	2 01E-04	2 00E-04	0 77	53 94	-690 6	1 00E-00	20042 6		
	Pb	1000	89 10	6 20E-00	J 5 44E-02	5 42E-02	5 43E-02	0 44	53 94	70 30	6 20E-00	87 54		
	Mg	1000	97 30	3 18E-00	J 4 82E-03	4 73E-03	4 78E-03	1 47	53 94	43 50	3 00E-01	1595 50		
	Mn	1000	64 60	3 00E-01	J 6 14E-03	6 14E-03	6 14E-03	0 03	53 94	-234 3	3 00E-01	30681 6		
	Ni	1000	89 70	1 70E-00	J 1 57E-02	1 57E-02	1 57E-02	0 17	53 94	84 50	1 70E-00	92 50		
	K	1000	101 80	1 62E-01	J 1 20E-03	1 22E-03	1 21E-03	1 61	53 94	38 70	1 12E-01	101 20		
	Se	1000	80 80	7 60E-00	UJ 7 63E-00	7 66E-00	7 60E-00	7 19	53 94	0 00	7 60E-00	0 97		
	Ag	1000	85 90	3 00E-01	J 2 28E-02	2 25E-02	2 27E-02	1 26	53 94	87 90	3 00E-01	433 38		
	Na	2000	133 00	1 10E-02	J 3 84E-04	3 87E-04	3 87E-04	0 22	107 87	-333 3	3 10E-00	12474 8		
	V	2000	88 60	-5 21E-01	J 2 15E-01	2 13E-01	2 14E-01	1 09	107 87	90 40	3 00E-01	42 86		
	Zn	2000	88 20	9 19E-01	J 1 04E-02	9 68E-03	1 01E-02	9 18	107 87	88 20	3 00E-01	338 14		
	Bi	1000	36 40	7 50E-00	J 2 32E-04	2 33E-04	2 33E-04	0 63	53 94	-319 0	7 50E-00	3107 78	0	
	B	1000	113 10	2 76E-01	UJ 2 16E-01	2 51E-01	2 34E-01	15 73	53 94	25 00	6 00E-01	39 04		
	Ce	1000	107 80	1 01E-01	UJ 2 83E-01	2 90E-01	2 86E-01	2 53	53 94	97 70	1 01E-01	2 83		
	La	1000	93 50	1 40E-00	J 3 59E-03	3 64E-03	3 62E-03	1 28	53 94	-58 40	1 40E-00	2587 33	0 01	
	P	2000	82 60	9 58E-00	J 9 98E-03	9 94E-03	9 96E-03	0 40	107 87	493 60	5 80E-00	1718 44	0 04	
	Si	2000	201 00	8 08E-01	J 5 24E-02	4 18E-02	4 71E-02	22 60	107 87	8 40	1 30E-00	362 27		
	Sr	2000	81 40	3 00E-01	J 2 80E-02	2 80E-02	2 80E-02	0 03	107 87	81 80	3 00E-01	933 73		
	S	1000	100 40	9 59E-00	J 1 27E-03	1 26E-03	1 26E-03	1 04	53 94	91 80	3 70E-00	467 42	0 17	
	Sn	1000	94 50	3 66E-00	UJ 3 13E-00	1 74E-00	2 44E-00	57 20	53 94	89 40	1 60E-00	1 52		
	Ti	1000	89 80	4 00E-01	J 3 27E-01	3 34E-01	3 30E-01	2 10	53 94	83 50	4 00E-01	82 56		
	Zr	2000	88 10	8 00E-01	UJ 7 50E-01	8 06E-01	7 78E-01	7 19	107 87	8 00	--	---		

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WHC-EP-0806

WHC-SD-WM-DP-024 ADDENDUM 2, REV 0

T-111 Core 31 Composite 2

Direct/Undiss	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIMI	Batch	mcq	Mst Bal
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	B/DL	Sma	(g/g)
	10434											
	DSC	EXO	NA	EXOTHERM	EXOTHERM	NA	NA	NA	NA	NA		
	10434			(S)	(S)	(S)						
	TGA	97.80	NA	71.20	69.20	70.20	2.83	NA	NA	NA		
	10.418,419			(S)	(S)	(S)						
S WATER	S WTR	99.70	NA	75.90	75.90	75.90	0.00	NA	NA	NA		0.739
	Lab 3427											
HYAA	As —	PNL										
	Se —	PNL										
CVAA	Hg	101.3	< 1.25	J 1.68E-00	1.79E-00	1.63E-00	4.10	122.00	1.25E-01	ERR		
	10.441											
CN-Dir	CN	99.90	<5.0	0.37 LLJ	0.41	NA	NA	88.10	5.00E-00	NA		
	CuNiFeCN6					NA						

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WHC-EP-0806
WHC-SD-WM-DP-024 ADDENDUM 2, REV 0

T-111 Core 31 Composite 2

	Analyte	LMCS Std added	LMCS Std % Rec	PREP BLK (ug/g)	Result #1 (ug/g)	Result #2 (ug/g)	Average (ug/g)	RPD %	Spk added (ug/L)	Spike % Rec	DET LIM (ug/g)	Ratio R/DL
38.459												
ICP-Water	Al	5000	95 60	2 40E-00	UJ 1 02E-01	1 04E-01	1 03E-01	1 70	1250	99.50	2 40E-00	4 29
	Sb	5000	98 40	1 77E-01	UJ 1 77E-01	1 77E-01	1 77E-01	0 00	1250	74.10	1 77E-01	1 00
	As	5000	91 40	3 00E-00	UJ 3 00E-00	3 00E-00	3 00E-00	0 00	2500	46 20	3 00E-00	1 00
	Be	10000	98 30	3 00E-01	UJ 5 32E-01	3 00E-01	4 16E-01	55 84	2500	98 80	3 00E-01	1 39
	Bi	10000	96 90	3 00E-01	UJ 9 99E-02	9 99E-02	9 99E-02	0 00	2500	98 60	3 00E-01	1 00
	Cd	10000	97 90	4 00E-01	UJ 4 00E-01	4 00E-01	4 00E-01	0 00	2500	97.20	4 00E-01	1 00
	Ca	10000	90 70	2 10E-01	UJ 6 89E-01	5 43E-01	6 16E-01	23.73	2500	91.00	4 40E-00	14 00
	Cr	5000	100 60	9 00E-01	J 2 30E-02	2 28E-02	2 29E-02	0 94	1250	98.80	9 00E-01	254 58
	Co	10000	96 40	8 00E-01	UJ 8 31E-01	7 99E-01	8 15E-01	4 22	2500	97.60	8 00E-01	1 03
	Cu	5000	95 80	4 00E-01	UJ 4 00E-01	4 00E-01	4 00E-01	0 00	1250	96 90	4 00E-01	1 00
	Fe	5000	97 00	1 00E-00	J 1 51E-02	1 30E-02	1 40E-02	15 57	1250	94.70	1 00E-00	140 47
	Pb	5000	94 00	6 20E-00	UJ 8 92E-00	6 83E-00	7 88E-00	25 10	1250	93.20	6 20E-00	1 28
	Mg	5000	98 70	6 60E-01	J 4 23E-00	3 66E-00	3 95E-00	14 41	1250	99.70	3 00E-01	33 16
	Mn	5000	93 60	2 00E-01	J 2 70E-01	2 31E-01	2 51E-01	15 27	1250	93.70	2 00E-01	125 26
	Ni	5000	97 30	1 70E-00	UJ 1 70E-00	1 70E-00	1 70E-00	0 00	1250	98.10	1 70E-00	1 00
	K	5000	101 10	1 12E-01	J 7 83E-02	7 83E-02	7 83E-02	0 00	1250	85.10	1 12E-01	69 93
	Se	5000	93 90	7 60E-00	UJ 8 44E-00	7 59E-00	8 01E-00	10 53	1250	101.80	7 60E-00	1 05
	Ag	5000	101 00	5 00E-01	UJ 1 07E-00	1 26E-00	1 16E-00	16 47	1250	102.50	5 00E-01	2 32
	Na	10000	96 60	2 88E-01	J 3 50E-04	3 51E-04	3 50E-04	0 14	2500	-27.70	3 10E-00	11301 4
	V	10000	95 50	5 00E-01	UJ 8 20E-01	5 94E-01	7 07E-01	31 89	2500	97.60	5 00E-01	1 41
	Zn	10000	97 90	-5 49E-00	UJ 3 00E-01	3 00E-01	3 00E-01	0 00	2500	97.00	3 00E-01	1 00
	Bi	5000	99 60	7 50E-00	J 2 05E-02	1 76E-02	1 91E-02	15 42	1250	59 90	7 50E-00	25 42
	B	5000	87 80	6 00E-01	J 3 12E-00	3 27E-00	3 19E-00	4 72	1250	86.10	6 00E-01	5 32
	Ca	5000	99 00	1 01E-01	UJ 1 01E-01	1 01E-01	1 01E-01	0 00	1250	99.30	1 01E-01	1 00
	La	5000	99 10	1 40E-00	J 9 35E-00	7 69E-00	8 52E-00	19 53	1250	100.50	1 40E-00	6 09
	P	10000	95 40	5 80E-00	J 6 11E-03	5 81E-03	5 96E-03	5 01	2500	82.80	5 80E-00	1027 04
	Si	10000	80 00	1 30E-00	J 5 89E-02	5 30E-02	5 60E-02	10 68	2500	99.10	1 30E-00	430 39
	Sr	10000	97 80	3 00E-01	J 2 29E-00	1 97E-00	2 13E-00	14 98	2500	99 00	3 00E-01	7 10
	S	5000	97 10	2 70E-00	J 1 21E-03	1 19E-03	1 20E-03	0 96	1250	93.70	2 70E-00	444 44
	Sn	5000	92 70	1 60E-00	UJ 1 60E-00	1 60E-00	1 60E-00	0 00	1250	93 00	1 60E-00	1 00
	Ti	5000	97 80	4 00E-01	UJ 4 00E-01	4 00E-01	4 00E-01	0 00	1250	99 40	4 00E-01	1 00
	Zr	10000	91 30	8 00E-01	UJ 7 99E-01	7 99E-01	7 99E-01	0 00	--	--	--	

T-111 Core 31 Composite 2

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	meq	Mat Bal
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	R/DL	Ions	(g/g)
	18.459											
IC-Water	F	109.5	<1.00E+1	J 3.09E+03	3.16E+03	3.13E+03	2.24	73.90	1.00E+01	312.50	0.16	0.00
	Cl	96.00	<1.00E+1	J 4.75E+02	5.18E+02	4.97E+02	8.66	76.00	1.00E+01	49.65		0.00
	NO3	99.80	<1.00E+2	J 4.39E+04	4.36E+04	4.38E+04	0.69	80.30	1.00E+02	437.50	0.71	0.04
	NO2	96.60	<1.00E+2	UJ <1.099E3	8.71E+01	NA	NA	87.90	1.00E+02	NA		0.00
	PO4	97.90	<1.00E+2	J 1.77E+04	1.71E+04	1.74E+04	3.45	70.40	1.00E+02	174.00		0.03
	SO4	96.90	<1.00E+2	J 3.75E+03	3.72E+03	3.74E+03	0.80	83.20	1.00E+02	37.35		0.01
	P ACID ICP/PO4 IC					1.35E+00						
	S ACID ICP/SO4 IC					1.01E+00						
	18.459											
Spec-water	NO3	100.0	<5.00E+1	J 5.27E+02	5.22E+02	5.25E+02	0.95	97.30	5.00E+01	10.49		0.00
	NO3 (IC)/NO3 Spec.					83.41						
	NO3 (IC)/NO3 (SPEC)					NA						
	18.459											
pH	pH	100.7	NA	J 9.94	9.91	9.93	0.30	NA	NA	NA		
	18.459											
NH3-Water	NH3	87.80	<4500	<4500 UJ	<4500	NA	NA	88.40	4.50E+03	NA		
	18.459											
TOC-Water	TOC	98.30	<650	J 3.85E+03	4.12E+03	3.99E+03	6.78	93.80	5.00E+02	8.24		
	Acetate Eq		1.96E-04								0.333	0.000
	18.459											
TIC-water	CO3	103.3	<500	UJ 9.99E+02	8.49E+02	8.24E+02	42.44	103.50	5.00E+02	1.65	0.027	0.001

T-111 Core 31 Composite 2

	Analyte	LMCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio	meq	Mas
96467		added	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/L)	% Rec	(ug/g)	R/DL	Ions	(g
ICP-Fusion	Al	5000	93 30	1 20E-01	J 7 06E-02	6 80E-02	6 93E-02	3 87	1250	94 20	1 20E-01	57 76		
	Sb	5000	90 70	8 83E-01	UJ 8 83E-01	8 83E-01	8 83E-01	0 00	1250	101 80	8 83E-01	1 00		
	As	5000	91 30	1 50E-01	UJ 1 50E-01	1 50E-01	1 50E-01	0 00	2500	44 80	1 50E-01	1 00		
	Ba	10000	97 00	1 50E-00	J 6 15E-01	5 96E-01	6 06E-01	3 09	2500	98 00	1 50E-00	40 37		
	Be	10000	99 80	1 15E-00	UJ 4 99E-01	4 99E-01	4 99E-01	0 00	2500	99 70	5 00E-01	1 00		
	Cd	10000	99 60	2 00E-00	J 1 41E-01	7 18E-00	1 07E-01	65 11	2500	100 40	2 00E-00	5 33		
	Ca	10000	92 40	1 28E-01	J 2 83E-03	2 49E-03	2 66E-03	12 55	2500	94 80	2 20E-01	120 96		
	Cr	5000	102 30	4 50E-00	J 1 73E-03	1 67E-03	1 70E-03	3 37	1250	106 00	4 50E-00	377 27		
	Co	10000	99 10	4 00E-00	UJ 1 03E-01	1 11E-01	1 08E-01	4 91	2500	99 60	4 00E-00	2 70		
	Cu	5000	93 60	3 35E-00	J 3 42E-01	3 41E-01	3 42E-01	0 32	1250	96 30	2 00E-00	17 09		
	Fe	5000	97 80	7 13E-01	J 1 97E-04	1 95E-04	1 96E-04	1 36	1250	123 50	5 00E-00	3918 94		
	Pb	5000	91 70	3 10E-01	J 4 84E-02	4 82E-02	4 84E-02	0 89	1250	88 90	3 10E-01	15 62		
	Mg	5000	99 50	1 34E-01	J 4 36E-02	4 31E-02	4 43E-02	5 51	1250	100 90	1 50E-00	295 61		
	Mn	5000	94 60	5 04E-00	J 6 02E-03	5 86E-03	5 94E-03	2 71	1250	103 20	5 00E-00	5941 37		
	Ni	5000	98 80	3 91E-01	J 3 40E-03	7 49E-03	5 45E-03	75 09	1250	107 00	8 50E-00	641 00		
	K	5000	100 10	5 40E-01	UJ 5 39E-01	5 39E-01	5 39E-01	0 00	1250	1344 8	5 60E-01	1 00		
	Se	5000	93 20	3 80E-01	UJ 3 79E-01	3 79E-01	3 79E-01	0 00	1250	96 60	3 80E-01	1 00		
	Ag	5000	100 80	8 50E-00	J 2 26E-02	2 17E-02	2 21E-02	4 24	1250	103 10	2 50E-00	88 53		
	Na	10000	93 00	4 69E-01	J 3 94E-04	3 85E-04	3 90E-04	2 44	2500	109 80	3 55E-01	2513 61		
	V	10000	98 20	3 50E-00	J 1 74E-01	8 55E-01	8 65E-01	11 55	2500	99 90	2 50E-00	6 60		
	Zn	10000	99 60	-1 36E-01	J 1 00E-02	8 11E-02	8 06E-02	9 65	2500	99 80	1 50E-00	70 39		
	Bi	5000	94 40	3 75E-01	J 2 01E-04	2 02E-04	2 01E-04	0 55	1250	78 40	3 75E-01	337 33		
	B	5000	65 10	3 00E-00	UJ 2 99E-00	2 99E-00	2 99E-00	0 00	1250	83 10	3 00E-00	1 00		
	Ce	5000	101 30	5 03E-01	UJ 5 04E-01	5 04E-01	5 04E-01	0 00	1250	97 80	5 03E-01	1 00		
	La	5000	99 50	7 00E-00	J 3 45E-03	3 38E-03	3 41E-03	2 16	1250	103 40	7 00E-00	487 65		
	P	10000	101 90	2 90E-01	J 1 11E-04	1 11E-04	1 11E-04	0 56	2500	103 70	2 90E-01	365 37		
	Si	10000	75 10	6 79E-01	J 5 89E-03	5 78E-03	5 84E-03	1 87	2500	79 10	6 50E-00	897 91	0 42	
	Sr	10000	93 30	1 50E-00	J 2 91E-02	2 70E-02	2 80E-02	7 72	2500	98 90	1 50E-00	186 98		
	Ti	5000	108 00	2 77E-01	J 1 33E-03	1 29E-03	1 31E-03	3 36	1250	102 60	1 35E-01	96 93		
	Sn	5000	93 00	-9 86E-00	UJ 7 98E-00	7 98E-00	7 98E-00	0 00	1250	93 80	8 00E-00	1 00		
	Tl	5000	96 80	2 00E-00	J 7 54E-01	7 13E-01	7 34E-01	5 88	1250	97 80	2 00E-00	36 68		
	Zr	10000	95 20	4 00E-00	UJ 3 99E-00	3 99E-00	3 99E-00	0 00	1250	--	--	--		

WHC-SD-WM-DP-024 ADDENDUM 2, REV 0

WHC-EP-0806

T-111 Core 31 Composite 2

			Water ICP/Acid ICP		Water ICP/Fusion ICP		Fusion ICP/Acid ICP	
Charge Bal	Tot Cat	3.76	Ca	0.12	Al	0.015	Al	0.98
	Tot An	3.70	Mn	0.00	Ca	0.135	Fe	0.98
	Cat/An	1.30	Si	2.00	Fe	0.007	Na	1.01
			S	0.95	Mn	0.004	Bi	0.87
Material Balance: oxide model		0.95	Na	0.91	Bi	0.009	Si	12.89
			Al	0.01	P	0.536	Ti	2.10
			K	0.65	Si	0.096	P	1.12
			P	0.60	Sr	0.006	Sr	1.00

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	meq	Mat Bal
		S Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	S	S	(ug/g)	S/DL	Mass	(g/g)
	18 467											
Fluor	U	104.6	<2.35E+2	J 3.75E-03	4.00E-03	3.88E-03	6.45	104.4	2.50E-02	33.50	0.033	0.004
	U as uCi/g					1.29E-03						
	Analyte	Std #1	Prep Blk	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	Rel.	
		S Rec	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	S	S	(uCi/g)	S/DL	Q Est	
	18 467											
RAD-Fus.	TA	103.9	<3.14E-3	J 3.69E-01	3.50E-01	3.59E-01	5.29	101.8	7.10E-03	50.63	3.10	
	TA/Pu-Am					2.01E+00						
	18 467											
	TB	96.10	<9.33E-2	2.13E-01	2.16E-01	2.15E-01	1.40	76.20	9.35E-02	229.41	1.20	
	TB/Co-Sr					1.00E+00						
	18 467											
GEA	Co-133	101.0	7.80E-04	2.38E-01	2.36E-01	2.37E-01	0.84	NA	3.70E-04	640.54	1.100	
	Eu-154	NA	<9.7E-4	3.24E-03	<1.06E-3	NA	NA	NA	1.20E-03	NA	33.000	
	Eu-155	NA	<6.15E-4	<3.12E-3	<2.13E-3	NA	NA	NA	3.95E-04	NA	NA	
	Am-241	NA	<1.17E-3	4.16E-02	4.02E-02	4.09E-02	3.42	NA	8.14E-03	35.88	33.500	
	Co-60	99.00	<3.36E-4	<3.73E-4	<3.83E-4	NA	NA	NA	4.07E-03	NA	NA	
	18 467											
	PU239/40	91.00	<3.60E-3	J 1.37E-01	1.34E-01	1.36E-01	2.21	81.70	3.60E-03	37.64	0.80	
	PU-238	NA	<3.60E-3	<1.04E-2	<1.03E-2	NA	NA	69.90		NA		

T-111 Core 31 Composite 2

	Analyte	Std #1 % Rec	Prep Blk (uCi/g)	Result #1 (uCi/g)	Result #2 (uCi/g)	Average (uCi/g)	RPD %	Spk Rec %	DET LOD (uCi/g)	Ratio R/DL	Rel. Q Err	
	28.467											
	Am-241	100 1	<3 70E-3	J 3 66E-02	4 66E-02	4 31E-02	16 24	9 60	3.70E-03	7.56	10.60	
								11.90			9 90	
	Cm-244			none detected		NA	NA	NA	NA	NA		
		Am-241 (GEA)/Am-241 (ALPHA)				9.49E-01						
	28.467											
	NP-237	70 30	<6 49E-3	UJ <3 24E-3	<3 24E-3	NA	NA	73 70	3.24E-03	NA	5 20	
	28.467											
	TC-99	118 3	<8 48E-4	4 56E-03	4.90E-03	4.73E-03	7.19	73.10	8 50E-04	5.56	4 60	
								71.30				
	28.467											
	I-129	119 3	<1 60E-2	UJ <1 92E-2	<2 40E-2	NA	NA	50.20	1.72E-02	NA		
								51.10				

A-52

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T-111 Core 31 Composite 2

Analyte	Std dl	Prep blk	Result #1	Result #2	Average	RPD	Std Rec	DET LIM	Blank	Q Err	ICLP Lim	Result/Lm
	R Rec	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	R	%	(uCi/g)	B/DL		(uCi/g)	
14 467												
Si-90	88 60	< 40E-3	7 31E-00	7 35E-00	7 43E-00	3 33	91 00	4 60E-03	1613 2	0 30		
14 439							92 00					
H-3	81 80	< 19E-4	< 13E-4	< 12E-4	< 12E-4	NA	81 30	3 13E-04	NA	4 600		
14 439												
C-14	81 30	< 23E-4	< 23E-4	< 23E-4	< 23E-4	NA	91 70	3 23E-04	NA	4 300		
14 1467												
Sr-79	NA	< 6 78E-3	< 6 31E-3	< 6 17E-3	NA	NA	89 10	5 63E-03	NA	4 300		
							91 20					
14 465												
Ag	99 40	3 00E-01	9 91E-02	NA	NA	NA	2 90	3 00E-03	19 03	3 00		0 02
Ba	97 80	3 00E-01	< 4 41E-02	NA	NA	NA	3 40	3 00E-03	14 71	100 00		0 00
Cd	97 00	4 00E-01	< 3 03E-02	NA	NA	NA	94 10	4 00E-03	3 04	1 00		0 02
Cs	103 30	9 00E-01	< 8 87E-00	NA	NA	NA	30 30	9 00E-03	905 31	3 00		1 71
Pb	98 30	6 30E-01	< 4 31E-01	NA	NA	NA	0 70	6 30E-03	3 27	3 00		0 09
As	93 90	3 00E-01	< 1 30E-01	NA	NA	NA	—	3 00E-03	5 00	3 00		0 01
Se	123 10	1 11E-01	< 8 60E-01	NA	NA	NA	—	3 60E-02	18 32	3 00		0 06
14 465												
ICLP-CVAA	97 30	< 0100	< 4 40E-01	NA	NA	NA	100 10	1 00E-02	4 40	0 30		0 21

T-111 Core Composite Summary

	C3ICC1			C3ICC2			C3JCC1			C3JCC2		
Analyte	Result #1	Result #2	Average	Result #1	Result #2	Average	Result #1	Result #2	Average	Result #1	Result #2	Average
ICP-acid	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)
Al	5.80E-02	5.80E-02	5.84E-02	7.07E-02	7.03E-02	7.05E-02	4.73E-02	4.71E-02	4.72E-02	4.04E-02	4.01E-02	4.03E-02
Sb	2.19E-01	3.90E-01	3.04E-01	1.69E-01	3.61E-01	3.65E-01	5.18E-01	2.00E-01	3.59E-01	2.61E-01	1.81E-01	2.26E-01
As	3.17E-00	3.03E-00	3.11E-00	2.81E-00	3.07E-00	2.92E-00	3.50E-00	3.39E-00	3.45E-00	2.90E-00	3.23E-00	3.06E-00
Ba	5.73E-01	5.66E-01	5.70E-01	6.46E-01	6.53E-01	6.49E-01	6.70E-01	6.67E-01	6.68E-01	8.79E-01	8.67E-01	8.73E-01
Be	1.06E-01	1.04E-01	1.05E-01	9.38E-02	1.01E-01	9.73E-02	1.20E-01	1.13E-01	1.17E-01	1.00E-01	1.04E-01	1.04E-01
Cd	7.23E-00	7.19E-00	7.22E-00	7.94E-00	7.78E-00	7.86E-00	4.70E-00	4.09E-00	4.40E-00	3.80E-00	3.64E-00	3.72E-00
Ce	2.36E-03	2.13E-03	2.20E-03	2.61E-03	2.36E-03	2.48E-03	1.50E-03	1.49E-03	1.49E-03	1.34E-03	1.33E-03	1.33E-03
Cr	1.89E-03	1.83E-03	1.86E-03	1.84E-03	1.84E-03	1.84E-03	2.08E-03	2.05E-03	2.06E-03	2.13E-03	2.14E-03	2.14E-03
Co	3.38E-00	3.42E-00	3.40E-00	3.17E-01	3.79E-00	3.76E-00	3.10E-00	3.15E-00	3.13E-00	2.70E-00	3.13E-00	2.91E-00
Cu	2.57E-01	2.48E-01	2.52E-01	3.17E-01	1.77E-02	7.96E-01	1.65E-01	1.64E-01	1.64E-01	1.30E-01	1.29E-01	1.30E-01
Fe	1.95E-04	1.89E-04	1.92E-04	2.00E-04	2.01E-04	2.00E-04	1.76E-04	1.74E-04	1.75E-04	1.72E-04	1.73E-04	1.73E-04
Pb	4.81E-02	4.69E-02	4.75E-02	5.44E-02	5.42E-02	5.43E-02	2.81E-02	2.80E-02	2.81E-02	1.69E-02	1.67E-02	1.68E-02
Mg	4.38E-02	4.33E-02	4.35E-02	4.82E-02	4.75E-02	4.79E-02	3.07E-02	3.02E-02	3.05E-02	2.92E-02	2.88E-02	2.90E-02
Mn	6.31E-03	6.07E-03	6.19E-03	6.14E-03	6.14E-03	6.14E-03	6.77E-03	6.63E-03	6.71E-03	6.23E-03	6.32E-03	6.28E-03
Ni	1.54E-02	1.48E-02	1.51E-02	1.57E-02	1.57E-02	1.57E-02	1.10E-02	1.09E-02	1.10E-02	1.01E-02	1.00E-02	1.01E-02
K	1.11E-03	1.08E-03	1.10E-03	1.20E-03	1.22E-03	1.21E-03	1.22E-03	1.21E-03	1.21E-03	1.02E-03	1.02E-03	1.02E-03
Se	8.04E-00	7.92E-00	7.98E-00	7.41E-00	7.66E-00	7.40E-00	1.20E-01	8.60E-00	1.03E-01	7.40E-00	8.18E-00	7.79E-00
Ag	2.03E-02	2.02E-02	2.03E-02	2.21E-02	2.25E-02	2.27E-02	4.39E-01	4.48E-01	4.43E-01	3.19E-01	2.81E-01	3.00E-01
Na	3.80E-04	3.71E-04	3.76E-04	3.84E-04	3.87E-04	3.87E-04	3.50E-04	3.49E-04	3.50E-04	3.67E-04	3.63E-04	3.63E-04
V	1.31E-01	1.23E-01	1.27E-01	2.15E-01	2.13E-01	2.14E-01	1.42E-01	1.35E-01	1.39E-01	1.04E-01	9.38E-00	9.99E-00
Zn	8.20E-01	7.68E-01	7.94E-01	1.06E-02	9.68E-01	1.01E-02	4.47E-01	4.36E-01	4.42E-01	3.54E-01	3.45E-01	3.50E-01
Bi	2.37E-04	2.34E-04	2.36E-04	2.32E-04	2.33E-04	2.33E-04	2.84E-04	2.84E-04	2.83E-04	2.82E-04	2.84E-04	2.84E-04
B	3.08E-01	3.34E-01	3.71E-01	2.16E-01	3.53E-01	2.34E-01	2.96E-01	2.92E-01	2.94E-01	3.23E-01	3.20E-01	3.22E-01
Ca	3.13E-01	3.39E-01	3.26E-01	2.03E-01	3.90E-01	2.86E-01	3.57E-01	4.00E-01	3.78E-01	3.89E-01	3.26E-01	3.58E-01
La	3.78E-03	3.66E-03	3.72E-03	3.59E-03	3.64E-03	3.62E-03	4.67E-03	4.61E-03	4.64E-03	4.86E-03	4.91E-03	4.89E-03
P	1.00E-04	1.02E-04	1.01E-04	9.98E-03	9.94E-03	9.96E-03	9.75E-03	9.97E-03	9.86E-03	1.14E-04	1.13E-04	1.13E-04
Si	4.36E-02	5.29E-02	4.82E-02	5.24E-02	4.18E-02	4.71E-02	4.80E-02	5.73E-02	5.28E-02	3.98E-02	4.90E-02	3.94E-02
Sr	2.85E-02	3.78E-02	3.82E-02	2.80E-02	2.80E-02	2.30E-02	3.01E-02	3.01E-02	3.05E-02	3.32E-02	3.37E-02	3.34E-02
S	1.24E-03	1.21E-03	1.23E-03	1.27E-03	1.26E-03	1.26E-03	1.14E-03	1.14E-03	1.14E-03	1.22E-03	1.22E-03	1.22E-03
Sn	4.13E-00	4.28E-00	4.21E-00	3.13E-00	1.74E-00	2.44E-00	1.80E-00	1.81E-00	1.81E-00	1.50E-00	1.72E-00	1.61E-00
Ti	2.93E-01	2.94E-01	2.94E-01	3.27E-01	3.34E-01	3.30E-01	8.80E-00	9.00E-00	8.90E-00	6.50E-00	6.42E-00	6.46E-00
Zr	8.47E-01	8.34E-01	8.40E-01	7.50E-01	8.06E-01	7.78E-01	9.20E-01	9.03E-01	9.11E-01	7.70E-01	8.61E-01	8.16E-01

T-111 Core Composite Summary

	C3ICC1			C3ICC2			C3JCC1			C3JCC2		
Analyte	Result #1 (ug/g)	Result #2 (ug/g)	Average (ug/g)	Result #1 (ug/g)	Result #2 (ug/g)	Average (ug/g)	Result #1 (ug/g)	Result #2 (ug/g)	Average (ug/g)	Result #1 (ug/g)	Result #2 (ug/g)	Average (ug/g)
DSC	EXOTHER	EXOTHER	NA	EXOTHER	EXOTHER	NA	NO EXO	NO EXO	NA	NO EXO	NO EXO	NA
	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)
TOA	83 30	61.30	73 30	7 12E-01	6 91E-01	7 02E-01	8 22E-01	8 10E-01	8 16E-01	8 30E-01	7.84E-01	8 08E-01
	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)	(S)
% WTR	74.40	74 80	74 60	7.59E-01	7.59E-01	7.59E-01	7.57E-01	7.72E-01	7.65E-01	7.64E-01	7.78E-01	7.71E-01
Hg	1.48E-00	1.70E-00	1 59	1 68E-00	1.79E-00	1 63E-00	1 22E-00	1 18E-00	1 20E-00	1.15E-00	1.02E-00	1.08E-00
CN	<4 0	<4 3	<4 3	<3 37	<3 41	NA	<4.81	<4.90	NA	<4.61	<4.76	NA

T-111 Core Composite Summary

	C3ICC1			C3ICC2			C3JCC1			C3JCC2		
Analyte	Result #1	Result #2	Average	Result #1	Result #2	Average	Result #1	Result #2	Average	Result #1	Result #2	Average
ICP-Water	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)
Al	6.43E-00	6.90E-00	6.71E-00	1.02E-01	1.04E-01	1.03E-01	1.77E-01	1.34E-01	1.55E-01	1.02E-01	1.18E-01	1.10E-01
Sb	1.77E-01	1.77E-01	1.77E-01	1.77E-01	1.77E-01	1.77E-01	1.77E-01	1.77E-01	1.77E-01	1.77E-01	1.77E-01	1.77E-01
As	3.00E-00	3.00E-00	3.00E-00	3.00E-00	3.00E-00	3.00E-00	2.99E-00	2.99E-00	2.99E-00	3.00E-00	3.00E-00	3.00E-00
Ba	3.00E-01	3.06E-01	3.03E-01	3.32E-01	3.00E-01	4.16E-01	7.15E-01	3.78E-01	5.47E-01	3.01E-01	3.32E-01	3.16E-01
Be	9.99E-02	1.00E-01	1.00E-01	9.99E-02	9.99E-02	9.99E-02	9.98E-02	9.98E-02	9.98E-02	9.99E-02	9.98E-02	9.99E-02
Cd	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	3.99E-01	3.99E-01	3.99E-01	4.00E-01	3.99E-01	3.99E-01
Ca	5.12E-01	5.03E-01	5.08E-01	6.89E-01	5.43E-01	6.16E-01	6.13E-01	7.16E-01	6.64E-01	6.15E-01	9.35E-01	6.75E-01
Cr	2.07E-02	2.11E-02	2.09E-02	2.30E-02	2.28E-02	2.29E-02	2.36E-02	2.22E-02	2.24E-02	2.09E-02	2.12E-02	2.11E-02
Co	7.99E-01	8.00E-01	8.00E-01	8.31E-01	7.99E-01	8.25E-01	8.43E-01	7.86E-01	8.21E-01	7.99E-01	8.30E-01	8.21E-01
Cu	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	3.99E-01	3.99E-01	3.99E-01	4.00E-01	3.99E-01	3.99E-01
Fe	1.02E-02	5.70E-01	7.96E-01	1.51E-02	1.30E-02	1.40E-02	1.47E-02	1.14E-02	1.31E-02	1.58E-02	1.60E-02	1.59E-02
Pb	6.19E-00	7.91E-00	7.05E-00	8.92E-00	6.83E-00	7.93E-00	6.36E-00	6.19E-00	6.24E-00	6.19E-00	6.19E-00	6.19E-00
Mg	3.22E-00	3.67E-00	3.94E-00	4.23E-00	3.66E-00	3.95E-00	4.08E-00	3.60E-00	3.84E-00	3.72E-00	3.95E-00	3.83E-00
Mn	1.95E-01	1.01E-01	1.47E-01	2.70E-01	2.51E-01	2.51E-01	3.04E-01	3.04E-01	2.54E-01	3.42E-01	3.54E-01	3.58E-01
Ni	1.70E-00	1.70E-00	1.70E-00	1.70E-00	1.70E-00	1.70E-00	1.70E-00	1.70E-00	1.70E-00	1.70E-00	1.70E-00	1.70E-00
K	7.21E-01	7.40E-01	7.34E-01	7.83E-01	7.83E-01	7.83E-01	7.19E-01	7.04E-01	7.11E-01	6.50E-01	6.47E-01	6.48E-01
Se	7.59E-00	7.60E-00	7.60E-00	8.44E-00	7.39E-00	8.01E-00	7.58E-00	7.58E-00	7.58E-00	7.39E-00	7.58E-00	7.59E-00
Ag	4.99E-01	7.79E-01	6.39E-01	1.07E-00	1.26E-00	1.16E-00	6.08E-01	4.99E-01	5.53E-01	4.99E-01	4.99E-01	4.99E-01
Na	3.39E-04	3.41E-04	3.40E-04	3.50E-04	3.51E-04	3.50E-04	3.09E-04	3.06E-04	3.06E-04	3.22E-04	3.19E-04	3.20E-04
V	4.99E-01	5.00E-01	5.00E-01	8.20E-01	5.94E-01	7.07E-01	4.99E-01	4.99E-01	4.99E-01	6.76E-01	9.21E-01	7.98E-01
Zn	3.00E-01	3.00E-01	3.00E-01	3.00E-01	3.00E-01	3.00E-01	2.99E-01	2.99E-01	2.99E-01	3.00E-01	2.99E-01	3.00E-01
Bi	1.47E-02	8.34E-01	1.15E-02	2.05E-02	1.76E-02	1.91E-02	2.58E-02	2.05E-02	2.31E-02	2.67E-02	2.73E-02	2.70E-02
B	5.51E-00	5.50E-00	5.51E-00	3.13E-00	3.27E-00	3.19E-00	5.54E-00	5.54E-00	5.54E-00	4.06E-00	4.64E-00	4.23E-00
Ce	1.01E-01	1.01E-01	1.01E-01	1.01E-01	1.01E-01	1.01E-01	1.01E-01	1.01E-01	1.01E-01	1.01E-01	1.01E-01	1.01E-01
La	7.05E-00	5.00E-00	6.02E-00	9.35E-00	7.69E-00	8.52E-00	8.55E-01	8.22E-01	8.38E-01	8.58E-01	8.87E-01	8.58E-01
P	5.09E-03	5.63E-03	5.76E-03	6.11E-03	5.81E-03	5.96E-03	5.34E-03	5.26E-03	5.30E-03	5.74E-03	5.66E-03	5.70E-03
Si	5.30E-02	5.45E-02	4.38E-02	5.89E-02	5.30E-02	5.60E-02	6.71E-02	6.68E-02	6.69E-02	6.18E-02	6.22E-02	6.20E-02
Sr	1.48E-00	9.34E-01	1.21E-00	2.29E-00	1.97E-00	2.13E-00	2.36E-00	1.97E-00	2.16E-00	2.29E-00	2.39E-00	2.34E-00
S	1.18E-03	1.21E-03	1.19E-03	1.21E-03	1.19E-03	1.20E-03	1.07E-03	1.05E-03	1.06E-03	1.14E-03	1.14E-03	1.14E-03
Sn	1.60E-00	1.60E-00	1.60E-00	1.60E-00	1.60E-00	1.60E-00	1.60E-00	1.60E-00	1.60E-00	1.60E-00	1.60E-00	1.60E-00
Ti	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	3.99E-01	3.99E-01	3.99E-01	4.00E-01	3.99E-01	3.99E-01
Zr	7.99E-01	8.00E-01	8.00E-01	7.99E-01	7.99E-01	7.99E-01	7.98E-01	7.98E-01	7.98E-01	7.99E-01	7.98E-01	7.99E-01

T-111 Core Composite Summary

	C31CC1			C31CC2			C33CC1			C33CC2		
Analyte	Result #1 (ug/g)	Result #2 (ug/g)	Average (ug/g)	Result #1 (ug/g)	Result #2 (ug/g)	Average (ug/g)	Result #1 (ug/g)	Result #2 (ug/g)	Average (ug/g)	Result #1 (ug/g)	Result #2 (ug/g)	Average (ug/g)
F	3.03E-03	3.14E-03	3.09E-03	3.09E-03	3.16E-03	3.13E-03	3.26E-03	3.47E-03	3.37E-03	1.59E-03	1.67E-03	1.63E-03
Cl	4.66E-02	4.73E-02	4.70E-02	4.75E-02	5.18E-02	4.97E-02	3.62E-02	4.40E-02	4.01E-02	4.23E-02	4.40E-02	4.32E-02
NO3	4.41E-04	4.43E-04	4.41E-04	4.39E-04	4.36E-04	4.38E-04	3.61E-04	3.76E-04	3.69E-04	4.03E-04	3.98E-04	4.01E-04
NO2	<1.099E3	<1.10E3	NA	<1.099E3	8.71E-02	NA	7.04E-02	8.42E-02	7.73E-02	7.04E-02	7.59E-02	7.32E-02
PO4	1.67E-04	1.56E-04	1.62E-04	1.77E-04	1.71E-04	1.74E-04	1.33E-04	1.56E-04	1.46E-04	1.50E-04	1.51E-04	1.51E-04
SO4	3.69E-03	3.69E-03	3.69E-03	3.75E-03	3.72E-03	3.74E-03	3.34E-03	3.23E-03	3.29E-03	3.52E-03	3.41E-03	3.47E-03
NO2	9.55E-02	9.49E-02	9.52E-02	5.27E-02	5.22E-02	5.25E-02	8.84E-02	8.72E-02	8.78E-02	8.60E-02	7.74E-02	8.17E-02
pH	1.02E-01	1.02E-01	1.02E-01	9.84E-00	9.91E-00	9.93E-00	1.00E-01	1.01E-01	1.00E-01	9.81E-00	9.72E-00	9.77E-00
NH3	<4500	<4500	NA	<4500	<4500	NA	<4500	<4500	NA	<4500	<4500	NA
TOC	3.68E-03	3.30E-03	3.49E-03	3.85E-03	4.12E-03	3.99E-03	2.00E-03	2.00E-03	2.00E-03	3.00E-03	3.00E-03	3.00E-03
TIC	6.50E-02	<5.0E-2	NA	9.99E-02	6.49E-02	8.24E-02	8.98E-02	7.69E-02	8.33E-02	7.99E-02	1.10E-03	9.50E-02

T-111 Core Composite Summary

	C31CC1			C31CC2			C33CC1			C33CC2		
Analyte	Result #1	Result #2	Average	Result #1	Result #2	Average	Result #1	Result #2	Average	Result #1	Result #2	Average
ICP Anion	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)	(ug/g)
Al	6.56E-02	6.33E-02	6.44E-02	7.06E-02	6.80E-02	6.93E-02	4.83E-02	4.83E-02	4.84E-02	4.59E-02	4.59E-02	4.59E-02
Sb	8.83E-01	8.87E-01	8.84E-01	8.83E-01	8.83E-01	8.83E-01	8.83E-01	1.29E-02	1.09E-02	8.83E-01	8.83E-01	8.84E-01
As	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01
Ba	6.04E-01	5.72E-01	5.88E-01	6.13E-01	5.94E-01	6.04E-01	6.48E-01	6.60E-01	6.54E-01	7.30E-01	7.45E-01	7.37E-01
Be	5.00E-01	5.01E-01	5.01E-01	4.99E-01	4.99E-01	4.99E-01	5.00E-01	4.99E-01	4.99E-01	4.99E-01	5.00E-01	4.99E-01
Cd	9.16E-00	7.54E-00	8.23E-00	1.41E-01	7.16E-00	1.07E-01	6.06E-00	6.76E-00	6.42E-00	7.48E-00	6.86E-00	7.17E-00
Ca	3.93E-03	2.58E-03	2.76E-03	2.63E-03	2.49E-03	2.66E-03	1.93E-03	2.50E-03	2.22E-03	1.92E-03	2.18E-03	2.03E-03
Cr	1.92E-03	1.86E-03	1.89E-03	1.73E-03	1.67E-03	1.70E-03	1.76E-03	1.81E-03	1.79E-03	1.82E-03	1.87E-03	1.87E-03
Co	1.05E-01	9.70E-00	1.01E-01	1.05E-01	1.11E-01	1.08E-01	1.30E-01	1.37E-01	1.33E-01	1.48E-01	9.80E-00	1.18E-01
Cu	3.59E-01	3.68E-01	3.63E-01	3.42E-01	3.41E-01	3.42E-01	2.26E-01	2.36E-01	2.31E-01	2.61E-01	2.30E-01	2.46E-01
Fe	2.01E-04	2.02E-04	2.01E-04	1.97E-04	1.95E-04	1.96E-04	1.57E-04	1.62E-04	1.59E-04	1.61E-04	1.61E-04	1.61E-04
Pb	4.55E-02	4.37E-02	4.46E-02	4.84E-02	4.82E-02	4.84E-02	2.72E-02	2.61E-02	2.67E-02	2.67E-02	2.72E-02	2.69E-02
Mg	4.52E-02	4.34E-02	4.38E-02	4.56E-02	4.31E-02	4.43E-02	2.38E-02	2.78E-02	2.68E-02	2.69E-02	2.74E-02	2.72E-02
Mn	6.47E-03	6.19E-03	6.38E-03	6.02E-03	5.86E-03	5.94E-03	6.13E-03	6.29E-03	6.22E-03	6.59E-03	6.59E-03	6.59E-03
Ni	5.61E-03	5.14E-03	5.77E-03	5.40E-03	7.49E-03	5.45E-03	9.09E-03	9.49E-03	9.29E-03	1.43E-04	9.81E-03	1.21E-04
K	5.60E-01	5.61E-01	5.61E-01	5.59E-01	5.59E-01	5.59E-01	5.60E-01	5.59E-01	5.59E-01	5.59E-01	5.60E-01	5.59E-01
Se	3.80E-01	3.81E-01	3.80E-01	3.79E-01	3.79E-01	3.79E-01	3.80E-01	3.79E-01	3.80E-01	3.79E-01	3.80E-01	3.80E-01
Ag	2.18E-02	2.10E-02	2.14E-02	2.26E-02	2.17E-02	2.21E-02	4.00E-01	3.89E-01	3.95E-01	3.74E-01	3.69E-01	3.71E-01
Na	4.01E-04	3.96E-04	3.98E-04	3.94E-04	3.83E-04	3.90E-04	3.36E-04	3.41E-04	3.39E-04	3.52E-04	3.51E-04	3.52E-04
V	1.32E-01	1.11E-01	1.21E-01	1.74E-01	1.55E-01	1.65E-01	1.69E-01	1.36E-01	1.53E-01	1.51E-01	1.42E-01	1.47E-01
Zn	1.11E-02	9.71E-01	1.04E-01	1.00E-02	1.11E-02	1.06E-02	1.00E-02	1.10E-02	1.05E-02	1.18E-02	1.02E-02	1.10E-02
Bi	2.14E-04	2.05E-04	2.09E-04	2.01E-04	2.02E-04	2.01E-04	2.63E-04	2.66E-04	2.65E-04	2.61E-04	2.73E-04	2.67E-04
B	3.00E-00	3.01E-00	3.00E-00	2.99E-00	2.99E-00	2.99E-00	4.32E-00	5.36E-00	4.84E-00	5.10E-00	4.58E-00	4.84E-00
Co	5.03E-01	5.06E-01	5.06E-01	5.04E-01	5.04E-01	5.04E-01	5.05E-01	5.04E-01	5.04E-01	5.04E-01	5.03E-01	5.04E-01
La	3.73E-03	3.63E-03	3.69E-03	3.45E-03	3.38E-03	3.41E-03	4.43E-03	4.58E-03	4.51E-03	4.78E-03	4.84E-03	4.81E-03
P	8.19E-04	1.12E-04	5.16E-04	1.31E-04	1.31E-04	1.31E-04	9.13E-03	8.99E-03	9.07E-03	9.01E-03	9.01E-03	9.01E-03
Si	6.04E-03	5.68E-03	5.94E-03	5.89E-03	5.78E-03	5.84E-03	5.39E-03	5.32E-03	5.46E-03	5.41E-03	5.41E-03	5.41E-03
Sr	3.98E-02	3.08E-02	3.03E-02	3.01E-02	3.70E-02	3.80E-02	3.84E-02	3.97E-02	3.91E-02	3.36E-02	3.98E-02	3.67E-02
Ti	1.34E-03	1.33E-03	1.33E-03	1.33E-03	1.29E-03	1.31E-03	4.06E-03	4.06E-03	4.06E-03	4.16E-03	4.16E-03	4.16E-03
Sn	8.00E-00	8.02E-00	8.01E-00	7.96E-00	7.98E-00	7.98E-00	8.00E-00	7.98E-00	7.99E-00	7.98E-00	8.00E-00	7.99E-00
Ti	7.25E-01	7.32E-01	7.29E-01	7.34E-01	7.13E-01	7.24E-01	2.32E-01	2.35E-01	2.33E-01	2.31E-01	2.31E-01	2.41E-01
Zr	4.00E-00	4.01E-00	4.00E-00	3.99E-00	3.99E-00	3.99E-00	4.00E-00	3.99E-00	4.00E-00	3.99E-00	4.00E-00	4.00E-00

T-111 Core Composite Summary

Analyte	C101C1			C101C2			C101C1			C101C2		
	Result #1 (pCi/g)	Result #2 (pCi/g)	Average (pCi/g)	Result #1 (pCi/g)	Result #2 (pCi/g)	Average (pCi/g)	Result #1 (pCi/g)	Result #2 (pCi/g)	Average (pCi/g)	Result #1 (pCi/g)	Result #2 (pCi/g)	Average (pCi/g)
U	2.31E-03	2.14E-03	2.16E-03	3.31E-03	4.00E-03	3.81E-03	3.14E-03	3.01E-03	3.16E-03	1.62E-03	2.07E-03	1.85E-03
U as UCl_4			7.34E-04	1.29E-03					1.04E-03			6.47E-04
Analyte	Result #1 (pCi/g)	Result #2 (pCi/g)	Average (pCi/g)	Result #1 (pCi/g)	Result #2 (pCi/g)	Average (pCi/g)	Result #1 (pCi/g)	Result #2 (pCi/g)	Average (pCi/g)	Result #1 (pCi/g)	Result #2 (pCi/g)	Average (pCi/g)
TA	3.31E-01	3.39E-01	3.30E-01	3.69E-01	3.30E-01	3.39E-01	3.14E-01	3.74E-01	3.77E-01	3.70E-01	3.78E-01	3.79E-01
TA/^{99}Tc-Am			2.00E-03	2.01E-03					2.19E-00			2.57E-00
TB	2.07E-01	2.04E-01	2.04E-01	3.11E-01	3.16E-01	2.15E-01	8.32E-00	9.46E-00	9.39E-00	6.71E-00	8.95E-00	8.03E-00
TB/^{241}Am			9.94E-01	1.00E-00					9.11E-01			9.04E-01
Co-137	3.11E-01	3.12E-01	3.11E-01	3.34E-01	3.36E-01	3.37E-01	1.12E-01	1.15E-01	1.14E-01	1.04E-01	1.03E-01	1.01E-01
Eu-154	1.07E-03	1.09E-03	1.06E-03	3.24E-03	<1.06E-3	NA	<1.01E-11	<1.11E-3	NA	<9.64E-4	<1.03E-3	NA
Eu-155	<2.09E-3	<2.04E-3	NA	<2.12E-3	<2.13E-3	NA	3.16E-11	2.97E-03	3.07E-03	<1.49E-3	<1.49E-3	NA
Am-241	4.80E-02	4.37E-02	4.39E-02	4.11E-02	4.02E-02	4.09E-02	3.79E-02	3.95E-02	3.87E-02	4.61E-02	4.34E-02	4.41E-02
Co-60	<3.39E-4	<4.31E-4	NA	<3.11E-4	<3.85E-4	NA	<3.70E-4	<3.41E-4	NA	<4.15E-4	<4.29E-4	NA
PU239/40	1.41E-01	1.35E-01	1.30E-01	1.37E-01	1.34E-01	1.34E-01	1.29E-01	1.39E-01	1.34E-01	1.42E-01	1.35E-01	1.47E-01
PU-238	<1.07E-3	<1.04E-3	NA	<1.04E-3	<1.01E-3	NA	<1.00E-3	<1.05E-3	NA	<1.04E-3	<1.13E-3	NA
Am-241	3.85E-02	4.03E-02	4.14E-02	3.91E-02	4.44E-02	4.31E-02	3.94E-02	3.71E-02	3.82E-02	3.11E-02	4.44E-02	4.71E-02
Am-241(DEAY/Am-241(daughter)			1.11E-00			9.19E-01			1.01E-00			8.97E-01
Cm-244												
HF-237	<3.31E-2	<3.15E-2	NA	<3.31E-2	<3.40E-2	NA	<3.24E-2	<3.24E-2	NA	<3.21E-2	<3.24E-2	NA
TC-99	3.33E-01	4.03E-01	3.14E-01	4.56E-01	4.90E-01	4.71E-01	1.16E-01	1.17E-01	1.16E-01	1.01E-01	1.03E-01	1.04E-01
I-129	<1.77E-3	<1.74E-3	NA	<1.87E-3	<2.40E-3	NA	<1.44E-3	<2.13E-3	NA	<2.17E-3	<1.75E-3	NA

T-111 Core Composite Summary

Analyte	C3ICC1			C3ICC2			C3ICC1			C3ICC2		
	Result #1	Result #2	Average	Result #1	Result #2	Average	Result #1	Result #2	Average	Result #1	Result #2	Average
	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)
Sr-90	7.34E-00	6.97E-00	7.16E-00	7.31E-00	7.33E-00	7.32E-00	1.61E-00	1.41E-00	1.51E-00	1.62E-00	1.37E-00	1.50E-00
H-3	<2.15E-4	<2.15E-4	NA	<2.15E-4	<2.12E-4	NA	<2.15E-4	<2.15E-4	NA	<2.15E-4	<2.15E-4	NA
C-14	<2.35E-4	<3.80E-04	NA	<2.35E-4	<2.32E-4	NA	<2.35E-4	<2.33E-4	NA	<2.35E-4	<2.35E-4	NA
Sr-79	<4.11E-3	<4.05E-3	NA	<4.31E-3	<4.17E-3	NA	<1.31E-4	<1.23E-4	NA	<1.31E-4	<1.29E-4	NA

T-111 Core 33 Direct Segment Analyses

Segment 1

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.319						
	DSC	EXOTHERM	NA	EXOTHERM	EXOTHERM	NA	NA
	18.319						
	TGA	99.3	NA	77.8	NA	NA	NA
	18319						
% WATER		100.7	NA	81.1	79.8	80.4	1.67

Segment 2

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.323						
	DSC	EXOTHERM	NA	EXOTHERM	EXOTHERM	NA	NA
	18.323						
	TGA	99.5	NA	80.5	80.6	80.6	0.12
	18.323						
% WATER		98.1	NA	85.6	85.8	85.7	0.23

Segment 3

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18 324						
	DSC	EXOTHERM	NA	EXOTHERM J	NO EXO	NA	NA
	18 324						
	TGA	99 5	NA	88 5	NA	NA	NA
	18 324						
% WATER		98 1	NA	88.7	83 9	81 9	8 33

T-111 Core 33 Direct Segment Analyses

Segment 4

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.323						
	DSC	EXOTHERM	NA	NO EXO	NA	NA	NA
	18.325						
	TGA	99.3	NA	88.5	NA	NA	NA
	18325						
% WATER		98.1	NA	80.4	79.3	79.9	1.38

Segment 5

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.326						
	DSC	EXOTHERM	NA	NO EXO	NA	NA	NA
	18.326						
	TGA	99.5	NA	88.8	NA	NA	NA
	18.326						
% WATER		98.1	NA	79.3	77.0	78.2	2.94

Segment 6

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18 328						
	DSC	EXOTHERM	NA	NO EXO	NO EXO	NA	NA
	18 328						
	TGA	94.6	NA	84.7	84.0	84.4	0.83
	18328						
% WATER		101.0		78.3	78.8	78.5	0.38

T-111 Core 33 Direct Segment Analyses

Segment 7

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.330						
	DSC	EXOTHERM	NA	NO EXO	NA	NA	NA
	18.330						
	TGA	94.6	NA	85.8	NA	NA	NA
	18.330						
% WATER		101.0	NA	74.7	68.8	71.7	8.51

Segment 8

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.331						
	DSC	EXOTHERM	NA	NO EXO	NA	NA	NA
	18.331						
	TGA	94.6	NA	84.8	NA	NA	NA
	18.331						
% WATER		101.0	NA	J 75.4	no sample	NA	NA

Segment 9

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%
	18.332						
	DSC	EXOTHERM	NA	NO EXO	NO EXO	NA	NA
	18.332						
	TGA	94.6	NA	85.2	NA	NA	NA
	18.332						
% WATER		101.0	NA	77.0	74.9	76.0	2.76

Segment 1H-1

Analyte	LMCS 3rd	% Rec	PREP BLK	Result #1	Result #2	Average	RPD	Spike	DET LIM	Ratio
Ir 191	add (ug/g)		(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	Added (ug/g)	(ug/g)	S/DL
ICP-AES	1000	110.0	1.00E-01	1.90E-02	4.10E-02	3.00E-02	73.72	100.76	2.40E-00	172.61
Sb 123	1000	94.4	1.77E-01	1.33E-01	2.02E-01	1.68E-01	41.15	100.76	1.77E-01	1.59
As 193	1000	80.5	1.00E-00	4.74E-00	4.70E-00	4.72E-00	0.85	100.76	1.00E-00	1.59
Be 113	2000	84.8	1.01E-01	3.81E-01	4.41E-01	4.11E-01	14.64	201.51	1.00E-01	204.76
Be 143	2000	87.3	1.00E-01	1.81E-01	1.37E-01	1.59E-01	27.61	201.51	1.00E-01	1.59
Cd 226	2000	87.1	4.00E-01	2.30E-01	1.51E-01	1.91E-01	40.07	201.51	4.00E-01	47.88
Ca 43	2000	231.9	4.11E-03	4.09E-03	5.11E-03	4.60E-03	22.04	201.51	4.10E-00	1100.84
Cr 52	1000	91.7	9.00E-01	4.60E-01	3.11E-01	3.86E-01	38.78	100.76	9.00E-01	148.37
Co 59	2000	89.4	9.00E-01	4.13E-00	4.71E-00	4.71E-00	1.87	201.51	1.00E-01	1.98
Cu 63	1000	90.7	4.00E-01	8.84E-01	8.97E-01	8.91E-01	1.48	100.76	4.00E-01	222.09
Fe 54	1000	104.8	4.00E-00	1.04E-04	1.61E-04	1.32E-04	22.19	100.76	1.00E-00	1644.87
Fe 56	1000	88.1	4.37E-01	8.74E-01	9.11E-01	8.93E-01	12.23	100.76	4.30E-00	147.88
Mg 24	1000	88.8	8.14E-00	4.41E-01	4.03E-01	4.22E-01	10.18	100.76	1.00E-01	1845.93
Mn 55	1000	87.8	1.00E-01	1.11E-04	1.34E-04	1.23E-04	11.63	100.76	1.00E-01	1.98
Ni 61	1000	91.1	1.70E-00	1.40E-01	1.11E-01	1.26E-01	11.32	100.76	1.70E-00	116.11
K 39	1000	109.1	1.30E-01	1.11E-01	1.07E-01	1.09E-01	3.76	100.76	1.13E-01	1.59
Se 82	1000	81.8	7.40E-00	1.33E-01	1.11E-01	1.22E-01	2.15	100.76	7.40E-00	1.59
Ag 107	1000	94.7	1.00E-01	4.22E-01	4.04E-01	4.13E-01	4.38	100.76	1.00E-01	870.34
Na 23	2000	111.7	3.77E-01	2.11E-04	2.30E-04	2.20E-04	8.60	201.51	3.00E-01	2103.18
V 51	2000	87.1	4.44E-01	1.47E-01	1.07E-01	1.27E-01	32.73	201.51	3.00E-01	31.43
Zn 66	2000	87.8	8.11E-00	3.11E-01	2.31E-01	2.71E-01	8.01	201.51	3.00E-01	807.60
Bi 209	1000	7.8	4.11E-01	7.03E-01	7.44E-01	7.24E-01	30.71	100.76	7.50E-00	96.16
B 117	1000	77.3	4.89E-01	8.41E-01	9.34E-01	8.87E-01	3.34	100.76	4.00E-01	1.59
Ca 43	1000	110.0	1.01E-01	1.04E-01	1.79E-01	1.79E-01	17.35	100.76	1.01E-01	1.77
La 139	1000	97.8	1.40E-00	3.11E-00	2.77E-00	2.77E-00	34.70	100.76	1.40E-00	1.98
P 31	2000	94.9	1.30E-01	4.31E-01	4.34E-01	4.34E-01	4.73	201.51	1.00E-01	711.01
Si 28	2000	49.1	1.01E-01	4.34E-01	4.31E-01	4.33E-01	0.63	201.51	1.30E-00	334.14
Sr 88	2000	84.4	3.34E-01	9.90E-01	1.10E-01	1.04E-01	10.13	201.51	3.00E-01	347.19
S 34	1000	111.3	1.41E-01	2.11E-02	2.77E-02	2.44E-02	0.74	100.76	2.70E-00	287.74
Sn 118	1000	94.8	2.40E-00	1.40E-01	3.11E-01	3.11E-01	1.87	100.76	1.40E-00	16.11
Ti 47	1000	91.2	4.00E-01	4.00E-01	3.77E-01	3.88E-01	4.38	100.76	4.00E-01	128.33
Zr 105	2000	89.0	8.00E-01	1.78E-00	1.34E-00	1.77E-00	2.14	201.51	8.00E-01	--

Analyte	LMCS 3rd	PREP BLK	Result #1	Result #2	Average	RPD	Spike	DET LIM	Ratio
Ir 191	(%)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	%	% Rec	(uCi/g)	S/DL
TA	104.3	<6.11E-03	6.72E-01	6.41E-01	6.41E-01	2.33	104.3	2.00E-02	32.36
Ir 191									
Co-137	101.0	<7.5E-3	4.06E-01	4.07E-01	4.01E-01	0.25	NA	1.30E-01	3420.0
Eu-154	NA	<1.91E-4	2.11E-03	2.17E-03	2.11E-03	1.94	NA	1.40E-04	69.36
Eu-155	NA	<1.14E-4	2.14E-03	2.31E-03	2.22E-03	1.03	NA	1.18E-04	229.33
Am-241	NA	<2.11E-4	1.34E-01	1.34E-01	1.34E-01	0.00	NA	2.18E-04	196.49
Co-60	101.0	<7.6E-3	6.32E-03	5.94E-03	6.09E-03	7.55	NA	1.18E-03	14.72

T-111 Hanford-Issue Analyses for Case 33

Sequoyah 1H-3

Analyte	LHCS Std	PREP BLK	Result #1	Result #2	Average	RPD	Split	DET LIM	Ratio
1# 399	add (ug/l)	B Rec	(ug/l)	(ug/l)	(ug/l)	B	Spike add	B Rec	DET LIM
ICP-AES						(ug/l)	(ug/l)	(ug/l)	B/DL
Al	1000	110 0	1 04E-01	4 17E-02	1 07E-01	1 14E-02	1 00E+00	110 76	1 77E-01
Sb	1000	104 4	1 77E-01	1 97E-01	3 04E-01	3 00E-01	3 00E+00	110 76	1 77E-01
As	1000	110 5	3 00E-00	4 14E-00	3 44E-00	3 10E-00	10 00	117 76	9 3 8
Ba	1000	110 0	3 41E-01	4 17E-01	4 09E-01	6 09E-01	3 32	237 33	83 3
Be	1000	107 2	1 00E-01	1 11E-01	1 13E-01	1 13E-01	3 31	237 33	84 9
Cd	1000	107 1	4 00E-01	4 43E-01	4 41E-01	4 42E-01	0 92	237 33	81 4
Ca	2000	211 0	4 11E-02	4 73E-03	4 10E-03	4 10E-03	3 06	237 33	147 3
Cr	1000	91 7	9 00E-01	5 01E-02	4 80E-03	4 97E-02	4 44	118 76	123 9
Co	1000	89 4	8 00E-01	4 63E-00	4 51E-00	4 57E-00	3 33	237 33	86 4
Cu	1000	90 7	4 00E-01	8 43E-01	8 37E-01	8 37E-01	1 31	118 76	83 3
Fe	1000	106 6	4 69E-00	1 40E-04	1 47E-04	1 41E-04	1 38	118 76	-243 7
Pb	1000	88 7	6 20E-00	9 34E-02	8 85E-02	9 10E-02	7 47	118 76	95 1
Mg	1000	91 0	8 34E-00	8 03E-02	7 90E-02	7 94E-02	1 36	118 76	107 3
Mn	1000	87 0	3 00E-01	3 41E-04	3 44E-04	3 43E-04	2 23	118 76	2346 3
Ni	1000	91 3	1 70E-00	3 34E-02	3 29E-02	3 33E-02	2 36	118 76	93 0
K	1000	109 1	1 30E-01	1 12E-03	1 11E-03	1 12E-03	0 40	118 76	157 1
Se	1000	81 0	7 60E-00	8 44E-00	8 07E-00	8 60E-00	3 42	118 76	81 3
Ag	1000	90 7	3 00E-01	7 44E-03	3 04E-03	5 44E-03	61 87	118 76	49 3
Na	2000	131 7	3 73E-01	3 39E-04	3 30E-04	3 29E-04	0 33	237 33	610 8
V	2000	92 1	-6 46E-01	1 31E-01	1 37E-01	1 71E-01	0 33	237 33	90 7
Zn	2000	92 0	8 81E-00	3 67E-02	3 61E-02	3 64E-02	0 46	237 33	84 0
Bi	1000	7 9	-4 15E-01	7 04E-03	7 15E-03	7 44E-03	2 29	118 76	102 0
B	1000	77 3	6 89E-01	6 67E-01	6 81E-01	6 79E-01	3 61	118 76	63 0
Ca	1000	110 0	1 01E-01	1 35E-01	1 18E-01	1 34E-01	20 62	118 76	109 4
La	1000	97 0	1 40E-00	2 97E-00	1 61E-00	2 29E-00	39 34	118 76	86 1
P	2000	91 0	1 30E-01	4 31E-03	4 31E-03	4 17E-03	6 41	237 33	33 3
Si	2000	49 0	1 01E-01	3 32E-02	3 30E-02	3 34E-02	3 78	237 33	134 9
Sr	2000	88 4	3 34E-01	1 04E-02	1 07E-02	1 03E-02	0 33	237 33	87 0
Ti	1000	113 2	1 41E-01	6 03E-02	6 01E-02	6 02E-02	0 18	118 76	100 0
Sn	1000	94 6	3 60E-00	2 16E-01	1 81E-01	2 01E-01	15 40	118 76	83 0
W	1000	91 7	4 00E-01	7 04E-01	6 91E-01	7 00E-01	1 66	118 76	89 0
Zr	3000	89 0	6 00E-01	9 22E-01	6 89E-01	9 02E-01	3 62	237 33	60 0
1# 399									
Cs-137	100 0	<7 35E-3	3 96E-01	4 00E-01	3 98E-01	1 01	NA	7 30E-03	5306 7
Eu-154	NA	<1 91E-4	3 09E-03	3 13E-03	3 11E-03	1 90	NA	2 40E-04	87 92
Eu-155	NA	<1 16E-4	3 73E-03	3 45E-03	3 49E-03	3 97	NA	1 19E-04	226 03
Am-241	NA	<3 25E-4	1 40E-01	1 39E-01	1 40E-01	0 72	NA	3 21E-04	611 84
Co-60	100 0	<7 46E-5	5 16E-03	5 11E-03	5 13E-03	0 56	NA	6 13E-05	63 18

T-111 Unequilibrated Analyses For Core 33

Analyte	LMCS Std		FILEP BLK	Result #1	Result #2	Average	RPD	Std Dev	DET LIM	Ratio
10 403	Add (µg/L)	% Rec	(µg/L)	(µg/L)	(µg/L)	(µg/L)	%	(µg/L)	(µg/L)	B/DL
Al	1000	104 6	1 42E-01	5 49E-02	5 44E-02	5 47E-02	0 95	116 76	137 7	1 40E-00	237 80
Sb	1000	87 3	1 77E-01	1 49E-01	1 93E-01	1 92E-01	16 12	116 76	91 7	1 77E-01	1 63
As	1000	91 3	3 00E-00	2 84E-00	2 94E-00	2 89E-00	3 51	117 76	93 8	3 00E-00	0 97
Ba	1000	87 3	3 34E-01	3 31E-01	3 49E-01	3 40E-01	0 58	237 53	18 3	3 00E-01	83 33
Be	1000	85 3	1 00E-01	9 34E-02	9 78E-02	9 56E-02	2 49	237 53	84 9	1 00E-01	0 97
Cd	1000	85 0	4 00E-01	3 20E-00	3 17E-00	3 18E-00	10 47	237 53	86 4	4 00E-01	3 43
Co	3000	154 9	1 11E-01	1 16E-01	1 14E-01	1 15E-01	4 04	237 53	147 3	4 00E-00	250 33
Cr	1000	91 0	8 00E-01	1 23E-01	1 21E-01	1 22E-01	1 67	116 76	135 7	8 00E-01	1547 48
Cu	3000	87 3	3 49E-00	3 14E-00	3 42E-00	3 28E-00	3 74	237 53	86 4	8 00E-01	4 20
Fe	1000	89 0	4 00E-01	4 42E-00	4 31E-00	4 37E-00	1 14	116 76	65 5	4 00E-01	16 18
Pb	1000	103 9	4 30E-00	4 30E-04	1 19E-04	1 30E-04	1 37	116 76	-343 7	1 00E-01	11946 3
Mg	1000	88 3	6 70E-00	1 04E-02	1 14E-02	1 09E-02	8 43	116 76	95 1	6 30E-00	17 38
Mn	1000	91 2	9 41E-00	2 01E-02	2 02E-02	2 02E-02	0 17	116 76	107 3	3 00E-01	672 16
Mo	1000	84 9	3 31E-01	3 07E-01	3 02E-01	3 04E-01	1 29	116 76	2344 3	3 00E-01	19709 0
Ni	1000	89 0	1 70E-00	6 84E-01	3 01E-01	6 91E-01	3 12	116 76	93 0	1 70E-00	40 70
K	1000	108 6	1 12E-00	1 63E-01	1 63E-01	1 63E-01	0 00	116 76	1377 1	1 12E-01	145 69
Si	1000	73 6	7 40E-00	3 31E-00	3 44E-00	3 38E-00	3 51	116 76	81 3	7 40E-00	0 97
Ag	1000	97 1	5 00E-01	2 00E-00	1 31E-00	1 70E-00	43 09	116 76	49 3	5 00E-01	3 39
Na	3000	119 2	5 61E-01	3 00E-01	2 91E-01	2 97E-01	1 69	237 53	96 7	5 00E-01	59 43
V	3000	89 6	5 00E-01	2 91E-01	2 91E-01	2 91E-01	0 00	237 53	116 0	3 10E-00	8433 43
Zn	3000	88 6	9 31E-00	1 44E-01	1 51E-01	1 48E-01	4 87	237 53	86 0	5 00E-01	53 33
Zr	1000	73 3	1 43E-00	3 77E-01	3 49E-04	3 63E-04	3 52	116 76	102 0	7 30E-00	3283 64
B	1000	104 3	1 01E-01	3 71E-01	3 68E-01	3 70E-01	0 82	116 76	109 4	1 01E-01	3 66
Ca	1000	94 3	4 00E-01	4 01E-01	4 00E-01	4 01E-01	0 34	116 76	84 1	1 40E-00	3867 31
P	1000	97 6	3 12E-01	4 80E-01	4 78E-01	4 79E-01	0 49	237 53	91 3	5 80E-00	825 66
Si	3000	44 4	9 03E-00	3 71E-02	3 69E-02	3 70E-02	0 34	237 53	154 9	1 30E-00	290 17
Sr	3000	84 9	3 62E-01	1 77E-02	1 74E-02	1 76E-02	0 85	237 53	87 6	5 00E-01	350 18
Ti	1000	130 3	1 31E-01	7 39E-02	7 30E-02	7 35E-02	1 27	116 76	100 9	2 70E-00	272 09
Sn	1000	94 0	6 05E-00	9 32E-00	9 07E-00	9 20E-00	14 49	116 76	83 0	1 40E-00	5 54
W	1000	89 6	1 31E-00	1 39E-02	1 33E-02	1 36E-02	2 49	116 76	84 3	1 00E-01	13 60
Zr	1000	86 9	6 00E-01	4 08E-00	3 91E-01	3 99E-01	2 12	170 39	89 6	4 00E-01	6 39
Li	2000	66 9	8 00E-01	7 63E-01	7 83E-01	7 73E-01	2 51	237 53	60 0	--	--
Ce-60		100 0		<7 6E-3	<7 3E-3		NA	3 11E-03	NA		
10 402											
Ce-137		101 0		<7 5E-3	1 37E-01	1 37E-01	0 00	NA	7 30E-03	1026 7	
Eu-154		NA		<1 91E-4	8 60E-04	8 70E-04	8 45E-04	1 16	NA	2 40E-04	1 60
Eu-155		NA		<1 16E-4	1 60E-03	1 60E-03	1 60E-03	0 00	NA	1 19E-04	13 45
Am-241		NA		<3 35E-4	1 41E-02	1 40E-02	1 40E-02	0 71	NA	2 30E-03	6 16
Co-60		100 0		<7 6E-3	4 60E-04	<7 3E-3		NA	8 11E-03	NA	
10 402											
Cs-137		101 0		<7 5E-3	1 37E-01	1 37E-01	0 00	NA	7 30E-03	1026 7	
Eu-154		NA		<1 91E-4	8 60E-04	8 70E-04	8 45E-04	1 16	NA	2 40E-04	1 60
Eu-155		NA		<1 16E-4	1 60E-03	1 60E-03	1 60E-03	0 00	NA	1 19E-04	13 45
Am-241		NA		<3 35E-4	1 41E-02	1 40E-02	1 40E-02	0 71	NA	2 30E-03	6 16
Co-60		100 0		<7 6E-3	4 60E-04	<7 3E-3		NA	8 11E-03	NA	

T-111 Homogenization Analyses For Core 33

Segment 3H-2

	Analyte	LMCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio
18.403		added	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/g)	% Rec	(ug/g)	R/DL
ICP-Acid	Al J	1000	104.6	1.42E-01	5.30E+02	5.32E+02	5.31E+02	0.39	110.76	137.7	2.40E+00	221.21
	Sb UJ	1000	87.3	1.77E-01	2.52E-01	2.64E-01	2.58E-01	4.72	110.76	91.7	1.77E-01	1.46
	As UJ	1000	91.5	3.00E+00	4.27E+00	3.93E+00	4.10E+00	8.46	117.76	93.8	3.00E+00	1.37
	Ba J	2000	87.3	3.30E-01	2.46E+01	2.37E+01	2.42E+01	3.75	237.53	88.3	3.00E-01	80.57
	Be UJ	2000	85.2	1.00E-01	1.42E-01	1.31E-01	1.37E-01	8.40	237.53	84.9	1.00E-01	1.37
	Cd J	2000	85.6	4.00E-01	2.00E+00	2.06E+00	2.03E+00	2.88	237.53	81.4	4.00E-01	5.09
	Ca UJ	2000	134.9	4.44E+01	1.14E+03	1.03E+03	1.09E+03	10.30	237.53	147.2	4.40E+00	247.14
	Cr J	1000	91.9	9.00E-01	1.16E+03	1.14E+03	1.15E+03	1.63	110.76	125.7	9.00E-01	1278.12
	Co UJ	2000	87.5	8.00E-01	3.62E+00	3.77E+00	3.70E+00	3.93	237.53	86.4	8.00E-01	4.62
	Cu J	1000	89.0	4.00E-01	6.62E+00	5.83E+00	6.23E+00	12.80	110.76	83.5	4.00E-01	15.56
	Fe J	1000	103.9	4.30E+00	1.14E+04	1.13E+04	1.14E+04	0.76	110.76	-263.7	1.00E+00	11358.2
	Pb J	1000	88.3	6.20E+00	1.08E+02	1.00E+02	1.04E+02	7.60	110.76	95.8	6.20E+00	16.77
	Mg J	1000	91.2	9.64E+00	1.93E+02	1.88E+02	1.90E+02	2.98	110.76	107.3	3.00E-01	634.70
	Mn J	1000	84.9	2.32E-01	3.70E+03	3.62E+03	3.66E+03	2.15	110.76	2384.2	2.00E-01	18304.0
	Ni J	1000	89.0	1.70E+00	6.63E+01	6.58E+01	6.60E+01	0.74	110.76	93.8	1.70E+00	38.83
	K J	1000	108.6	1.12E+00	1.75E+03	1.57E+03	1.66E+03	10.78	110.76	157.1	1.12E+01	148.00
	Se UJ	1000	73.6	7.60E+00	1.08E+01	9.95E+00	1.04E+01	8.46	110.76	81.3	7.60E+00	1.37
	Ag UJ	1000	97.1	5.00E-01	1.26E+00	1.54E+00	1.40E+00	18.97	110.76	40.5	5.00E-01	2.79
	Na J	2000	110.2	3.85E+01	2.56E+04	2.53E+04	2.54E+04	1.15	237.53	610.8	3.10E+00	8207.43
	V J	2000	89.8	5.00E-01	3.52E+01	2.88E+01	3.20E+01	19.99	237.53	90.7	5.00E-01	63.98
	Zn UJ	2000	88.8	9.35E+00	1.70E+01	1.50E+01	1.60E+01	12.63	237.53	88.8	3.00E-01	53.38
	Bi J	1000	7.5	-4.97E+01	2.38E+04	2.36E+04	2.37E+04	1.01	110.76	102.8	7.50E+00	3157.61
	B UJ	1000	75.2	1.63E+00	8.35E-01	7.85E-01	8.20E-01	8.44	110.76	63.8	6.00E-01	1.37
	Ce UJ	1000	104.5	1.01E+01	3.83E+01	4.19E+01	4.01E+01	8.91	110.76	109.4	1.01E+01	3.97
	La J	1000	96.1	1.40E+00	3.82E+03	3.79E+03	3.80E+03	0.76	110.76	84.1	1.40E+00	2717.00
	P J	2000	97.6	2.17E-01	4.90E+03	4.83E+03	4.86E+03	1.49	237.53	53.3	5.80E+00	838.59
	Si J	2000	46.4	9.93E+00	3.73E+02	3.85E+02	4.00E+02	30.61	237.53	154.9	1.30E+00	349.30
	Sr J	2000	84.0	3.62E-01	1.77E+02	1.67E+02	1.72E+02	5.79	237.53	87.8	3.00E-01	574.45
	S J	1000	120.2	1.32E+01	7.21E+02	7.08E+02	7.14E+02	1.85	110.76	100.9	2.70E+00	264.48
	Sn UJ	1000	94.0	6.95E+00	1.25E+01	1.08E+01	1.17E+01	14.25	110.76	83.0	1.60E+00	7.29
	Ti UJ	1000	89.8	4.00E-01	5.70E-01	5.24E-01	5.47E-01	8.45	118.76	89.8	4.00E-01	1.37
	Zr UJ	2000	86.9	8.00E-01	1.14E+00	1.05E+00	1.09E+00	8.46	237.53	60.9		—

	Analyte	LMCS Std	PREP BLK	Result #1	Result #2	Average	RPD	Spike	DET LIM	Ratio
	18.403	(%)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	%	% Rec	(uCi/g)	R/DL
RAD-Acid	TA	104.4	<8.05E-4	1.29E-01	1.33E-01	1.31E-01	3.05	104.7	1.83E-01	0.72
	18.403									
GEA	Cs-137	101.0	<7.5E-5	1.45E-01	1.39E-01	1.42E-01	4.23	NA	7.50E-05	1893.3
	Eu-154	NA	<1.91E-4	9.85E-04	<3.1E-4	NA	NA	NA	2.40E-04	NA
	Eu-155	NA	<1.16E-4	3.00E-01	1.90E-01	2.45E-01	44.90	NA	1.19E-04	20.59
	Am-241	NA	<2.25E-4	1.36E-02	1.40E-02	1.38E-02	2.90	NA	2.28E-03	6.05
	Co60	100.0	<7.6E-5	6.40E-04	4.40E-04	5.40E-04	37.04	NA	8.15E-05	6.63

T-111 Hexavalent Uranium Analyses for Core 33

Analyte	LMCS Std		PREP BLK	Beam #1	Beam #2	Average	RPD	Split	DET LIM	Ratio
ICP-AES #	ddLd	S Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	Spk Add	Rpt	DET LIM
Si	1000	104 6	1 41E-01	6 23E-03	6 43E-03	6 33E-03	3 23	110 76	1373	3 40E-00	264 73
Al	1000	97 5	1 77E-01	5 71E-01	6 13E-01	4 02E-01	15 60	110 76	91 3	1 77E-01	2 27
Ba	1000	97 3	3 34E-01	1 81E-02	1 86E-02	1 83E-02	3 43	110 76	91 0	3 00E-01	615 27
Ba	1000	91 2	1 00E-01	1 34E-01	1 31E-01	1 27E-01	18 34	110 76	84 0	1 00E-01	1 27
Ca	1000	91 3	6 00E-01	3 04E-00	2 94E-00	2 94E-00	4 44	110 76	81 4	4 00E-01	7 41
Ca	1000	134 9	4 44E-01	1 29E-03	1 34E-01	1 31E-03	3 64	110 76	147 3	4 00E-01	280 80
Cr	1000	91 9	6 00E-01	3 03E-03	3 10E-01	3 07E-01	3 43	110 76	135 7	4 00E-01	2295 75
Cu	1000	87 3	6 00E-01	1 31E-01	1 34E-01	1 33E-00	110 69	110 76	84 4	6 00E-01	18 27
Co	1000	89 0	6 00E-01	7 61E-00	8 33E-00	7 97E-00	8 04	110 76	83 3	6 00E-01	19 92
Fe	1000	109 9	6 30E-00	1 63E-04	1 67E-04	1 61E-04	3 59	110 76	-243 7	1 00E-00	1644 3
Pb	1000	88 3	6 30E-00	1 07E-02	1 10E-02	1 10E-02	18 44	110 76	95 1	6 30E-00	19 11
Mg	1000	91 2	9 60E-00	3 19E-02	3 34E-02	3 27E-02	4 49	110 76	107 3	9 00E-00	755 83
Mn	1000	87 9	1 32E-01	3 19E-03	2 90E-03	2 05E-03	3 74	110 76	2396 3	1 00E-00	14323 2
Ni	1000	89 0	1 70E-00	8 37E-01	8 93E-01	8 79E-01	4 18	110 76	93 0	1 70E-00	51 48
K	1000	104 6	1 12E-00	1 06E-03	1 10E-03	1 08E-01	3 54	110 76	137 1	1 12E-01	96 12
Si	1000	73 6	7 40E-00	1 02E-01	9 18E-00	9 68E-00	18 42	110 76	81 3	7 40E-00	1 27
Na	1000	97 1	3 00E-01	1 41E-00	1 12E-00	1 27E-00	23 67	110 76	49 5	3 00E-00	3 53
Na	3000	119 3	3 00E-01	3 10E-04	3 29E-04	3 23E-04	3 51	337 33	618 0	3 00E-00	10432 4
V	3000	89 8	3 00E-01	1 01E-01	1 19E-01	1 18E-01	14 87	337 33	90 7	3 00E-01	33 34
Zn	1000	66 6	9 33E-00	1 96E-01	2 00E-01	1 98E-01	1 93	337 33	86 0	3 00E-01	65 95
Bi	1000	73 3	-4 97E-01	3 31E-04	3 46E-04	3 41E-04	8 07	110 76	102 0	7 30E-00	4540 93
Ca	1000	73 2	1 63E-00	8 04E-01	7 32E-01	7 64E-01	10 43	110 76	63 0	6 00E-01	1 27
Ca	1000	104 3	1 01E-01	4 61E-01	4 85E-01	4 73E-01	7 81	110 76	199 4	1 01E-01	4 77
Ce	1000	94 8	1 40E-00	3 13E-03	3 34E-03	3 23E-03	3 83	110 76	86 1	1 40E-00	3733 17
P	3000	97 6	3 17E-01	8 74E-03	8 99E-03	8 87E-03	3 43	337 33	33 3	3 00E-00	1530 81
Si	3000	66 4	6 09E-00	3 45E-03	3 47E-02	3 46E-02	5 03	337 33	134 9	1 30E-00	774 16
S	3000	66 9	3 43E-01	3 31E-03	3 22E-02	3 27E-02	3 20	337 33	87 0	3 00E-01	1089 58
Li	1000	130 3	1 32E-01	1 01E-03	1 09E-03	1 07E-03	3 24	110 76	100 9	3 30E-00	395 75
Mo	1000	94 0	6 95E-00	1 37E-01	1 39E-01	1 38E-01	1 32	110 76	83 0	1 60E-00	8 64
Ti	1000	89 0	4 00E-01	3 00E-00	3 41E-00	3 20E-00	3 20	110 76	83 0	4 00E-01	5 60
Zr	3000	84 9	1 00E-01	1 07E-00	9 44E-01	1 03E-00	10 43	337 33	60 9	--	--

Reissue 3M-1

Analyte	LMCS Std		PREP BLK	Beam #1	Beam #2	Average	RPD	Spike	DET LIM	Ratio
ICP-AES #	ddLd	S Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	Spk Add	Rpt	DET LIM
Si	1000	104 6	1 41E-01	6 23E-03	6 43E-03	6 33E-03	3 23	110 76	1373	3 40E-00	264 73
Al	1000	97 5	1 77E-01	5 71E-01	6 13E-01	4 02E-01	15 60	110 76	91 3	1 77E-01	2 27
Ba	1000	97 3	3 34E-01	1 81E-02	1 86E-02	1 83E-02	3 43	110 76	91 0	3 00E-01	615 27
Ba	1000	91 2	1 00E-01	1 34E-01	1 31E-01	1 27E-01	18 34	110 76	84 0	1 00E-01	1 27
Ca	1000	91 3	6 00E-01	3 04E-00	2 94E-00	2 94E-00	4 44	110 76	81 4	4 00E-01	7 41
Ca	1000	134 9	4 44E-01	1 29E-03	1 34E-01	1 31E-03	3 64	110 76	147 3	4 00E-01	280 80
Cr	1000	91 9	6 00E-01	3 03E-03	3 10E-01	3 07E-01	3 43	110 76	135 7	4 00E-01	2295 75
Cu	1000	87 3	6 00E-01	1 31E-01	1 34E-01	1 33E-00	110 69	110 76	84 4	6 00E-01	18 27
Co	1000	89 0	6 00E-01	7 61E-00	8 33E-00	7 97E-00	8 04	110 76	83 3	6 00E-01	19 92
Fe	1000	109 9	6 30E-00	1 63E-04	1 67E-04	1 61E-04	3 59	110 76	-243 7	1 00E-00	1644 3
Pb	1000	88 3	6 30E-00	1 07E-02	1 10E-02	1 10E-02	18 44	110 76	95 1	6 30E-00	19 11
Mg	1000	91 2	9 60E-00	3 19E-02	3 34E-02	3 27E-02	4 49	110 76	107 3	9 00E-00	755 83
Mn	1000	87 9	1 32E-01	3 19E-03	2 90E-03	2 05E-03	3 74	110 76	2396 3	1 00E-00	14323 2
Ni	1000	89 0	1 70E-00	8 37E-01	8 93E-01	8 79E-01	4 18	110 76	93 0	1 70E-00	51 48
K	1000	104 6	1 12E-00	1 06E-03	1 10E-03	1 08E-01	3 54	110 76	137 1	1 12E-01	96 12
Si	1000	73 6	7 40E-00	1 02E-01	9 18E-00	9 68E-00	18 42	110 76	81 3	7 40E-00	1 27
Na	1000	97 1	3 00E-01	1 41E-00	1 12E-00	1 27E-00	23 67	110 76	49 5	3 00E-00	3 53
Na	3000	119 3	3 00E-01	3 10E-04	3 29E-04	3 23E-04	3 51	337 33	618 0	3 00E-00	10432 4
V	3000	89 8	3 00E-01	1 01E-01	1 19E-01	1 18E-01	14 87	337 33	90 7	3 00E-01	33 34
Zn	1000	66 6	9 33E-00	1 96E-01	2 00E-01	1 98E-01	1 93	337 33	86 0	3 00E-01	65 95
Bi	1000	73 3	-4 97E-01	3 31E-04	3 46E-04	3 41E-04	8 07	110 76	102 0	7 30E-00	4540 93
Ca	1000	73 2	1 63E-00	8 04E-01	7 32E-01	7 64E-01	10 43	110 76	63 0	6 00E-01	1 27
Ce	1000	104 3	1 01E-01	4 61E-01	4 85E-01	4 73E-01	7 81	110 76	199 4	1 01E-01	4 77
Ce	1000	94 8	1 40E-00	3 13E-03	3 34E-03	3 23E-03	3 83	110 76	86 1	1 40E-00	3733 17
P	3000	97 6	3 17E-01	8 74E-03	8 99E-03	8 87E-03	3 43	337 33	33 3	3 00E-00	1530 81
Si	3000	66 4	6 09E-00	3 45E-03	3 47E-02	3 46E-02	5 03	337 33	134 9	1 30E-00	774 16
S	3000	66 9	3 43E-01	3 31E-03	3 22E-02	3 27E-02	3 20	337 33	87 0	3 00E-01	1089 58
Li	1000	130 3	1 32E-01	1 01E-03	1 09E-03	1 07E-03	3 24	110 76	100 9	3 30E-00	395 75
Mo	1000	94 0	6 95E-00	1 37E-01	1 39E-01	1 38E-01	1 32	110 76	83 0	1 60E-00	8 64
Ti	1000	89 0	4 00E-01	3 00E-00	3 41E-00	3 20E-00	3 20	110 76	83 0	4 00E-01	5 60
Zr	3000	84 9	1 00E-01	1 07E-00	9 44E-01	1 03E-00	10 43	337 33	60 9	--	--

Analyte	LMCS Std		PREP BLK	Beam #1	Beam #2	Average	RPD	Spike	DET LIM	Ratio
RAD-Acid	TA	100 1	<1 74E-3	3 31E-01	3 40E-01	3 36E-01	1 63	185 0	1 53E-03	351 38
	IP 404									
QEA	Cs-137	101 0	<1 3E-3	8 80E-02	8 80E-02	8 80E-02	0 00	NA	9 30E-03	1173 3
	Eu-154	NA	<1 91E-4	<1 3E-4	<1 3E-4	<1 3E-4	NA	NA	2 40E-04	NA
	Eu-155	NA	<1 14E-4	<1 1E-4	<1 1E-4	<1 7E-4	NA	NA	1 19E-04	NA
	Am-241	NA	<1 31E-4	3 10E-02	3 00E-02	3 05E-02	4 66	NA	3 21E-03	6 99
	Co-60	100 0	<1 1E-3	<9 3E-3	<1 4E-3	NA	NA	NA	8 13E-03	NA

Analyte	LMCS Std		PREP BLK	Beam #1	Beam #2	Average	RPD	Spike	DET LIM	Ratio
ICP-AES #	ddLd	S Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	Spk Add	Rpt	DET LIM
Si	1000	104 6	1 41E-01	6 23E-03	6 43E-03	6 33E-03	3 23	110 76	1373	3 40E-00	264 73
Al	1000	97 5	1 77E-01	5 71E-01	6 13E-01	4 02E-01	15 60	110 76	91 3	1 77E-01	2 27
Ba	1000	97 3	3 34E-01	1 81E-02	1 86E-02	1 83E-02	3 43	110 76	91 0	3 00E-01	615 27
Ba	1000	91 2	1 00E-01	1 34E-01	1 31E-01	1 27E-01	18 34	110 76	84 0	1 00E-01	1 27
Ca	1000	91 3	6 00E-01	3 04E-00	2 94E-00	2 94E-00	4 44	110 76	81 4	4 00E-01	7 41
Ca	1000	134 9	4 44E-01	1 29E-03	1 34E-01	1 31E-03	3 64	110 76	147 3	4 00E-01	280 80
Cr	1000	91 9	6 00E-01	3 03E-03	3 10E-01	3 07E-01	3 43	110 76	135 7	4 00E-01	2295 75
Cu	1000	87 3	6 00E-01	1 31E-01	1 34E-01	1 33E-00	110 69	110 76	84 4	6 00E-01	18 27
Co	1000	89 0	6 00E-01	7 61E-00	8 33E-00	7 97E-00	8 04	110 76	83 3	6 00E-01	19 92
Fe	1000	109 9	6 30E-00	1 63E-04	1 67E-04	1 61E-04	3 59	110 76	-243 7	1 00E-00	1644 3
Pb	1000	88 3	6 30E-00	1 07E-02	1 10E-02	1 10E-02	18 44	110 76	95 1	6 30E-00	19 11
Mg	1000	91 2	9 60E-00	3 19E-02	3 34E-02	3 27E-02	4 49	110 76	107 3	9 00E-00	755 83
Mn	1000	87 9	1 32E-01	3 19E-03	2 90E-03	2 05E-03	3 74	110 76	2396 3	1 00E-00	14323 2
Ni	1000	89 0	1 70E-00	8 37E-01	8 93E-01	8 79E-01	4 18	110 76	93 0	1 70E-00	51 48
K	1000	104 6	1 12E-00	1 06E-03	1 10E-03	1 08E-01	3 54	110 76	137 1	1 12E-01	96 12
Si	1000	73 6	7 40E-00	1 02E-01	9 18E-00	9 68E-00	18 42	110 76	81 3	7 40E-00	1 27
Na	1000	97 1	3 00E-01	1 41E-00	1 12E-00	1 27E-00	23 67	110 76	49 5	3 00E-00	3 53
Na	3000	119 3	3 00E-01	3 10E-04	3 29E-04	3 23E-04	3 51	337 33	618 0	3 00E-00	10432 4
V	3000	89 8	3 00E-01	1 01E-01	1 19E-01	1 18E-01	14 87	337 33	90 7	3 00E-01	33 34
Zn	1000	66 6	9 33E-00	1 96E-01	2 00E-01	1 98E-01	1 93	337 33	86 0	3 00E-01	65 95
Bi	1000	73 3	-4 97E-01	3 31E-04	3 46E-04	3 41E-04	8 07	110 76	102 0	7 30E-00	4540 93
Ca	1000	73 2	1 63E-00	8 04E-01	7 32E-01	7 64E-01	10 43	110 76	63 0	6 00E-01	1 27
Ce	1000	104 3	1 01E-01	4 61E-01	4 85E-01	4 73E-01	7 81	110 76	199 4	1 01E-01	4 77
Ce	1000	94 8	1 40E-00	3 13E-03	3 34E-03	3 23E-03	3 83	110 76	86 1	1 40E-00	3733 17
P	3000	97 6	3 17E-01	8 74E-03	8 99E-03	8 87E-03	3 43	337 33	33 3	3 00E-00	1530 81
Si	3000	66 4	6 09E-00	3 45E-03	3 47E-02	3 46E-02	5 03	337 33	134 9	1 30E-00	774 16
S	3000	66 9	3 43E-01	3 31E-03	3 22E-02	3 27E-02	3 20	337 33	87 0	3 00E-01	1089 58
Li	1000	130 3	1 32E-01	1 01E-03	1 09E-03	1 07E-03	3 24	110 76	100 9	3 30E-00	395 75
Mo	1000	94 0	6 95E-00	1 37E-01	1 39E-01	1 38E-01	1 32	110 76	83 0	1 60E-00	8 64
Ti	1000	89 0	4 00E-01	3 00E-00	3 41E-00	3 20E-00	3 20	110 76	83 0	4 00E-01	5 60
Zr	3000	84 9	1 00E-01	1 07E-00	9 44E-01	1 03E-00	10 43	337 33	60 9	--	--

T-111 Homogenization Analyses For Core 33

Segment 3H-2

I# 405	Analyte	LMCS Std added	% Rec	PREP BLK (ug/g)	Result #1 (ug/g)	Result #2 (ug/g)	Average (ug/g)	RPD %	Spk add (ug/g)	Spike % Rec	DET LIM (ug/g)	Ratio R/DL
ICP-Acid	Al J	1000	104.6	1.42E-01	6.08E+02	5.84E+02	5.96E+02	3.98	110.76	137.7	2.40E+00	248.31
	Sb UJ	1000	87.3	1.77E-01	4.29E-01	3.00E-01	3.65E-01	35.45	110.76	93.7	1.77E-01	2.06
	As UJ	1000	91.5	3.00E+00	3.97E+00	4.43E+00	4.20E+00	10.88	117.76	93.8	3.00E+00	1.40
	Ba J	2000	87.3	3.34E-01	1.82E+02	1.74E+02	1.78E+02	4.33	237.53	88.3	3.00E-01	592.35
	Be UJ	2000	85.2	1.00E-01	1.32E-01	1.47E-01	1.40E-01	10.86	237.53	84.9	1.00E-01	1.40
	Cd J	2000	85.0	4.00E-01	3.00E+00	3.07E+00	3.04E+00	2.27	237.53	83.4	4.00E-01	7.59
	Ca UJ	2000	134.8	4.44E-03	1.30E+03	1.29E+03	1.30E+03	0.88	237.53	147.2	4.40E+00	294.52
	Cr J	1000	91.8	9.00E-01	2.01E+03	1.95E+03	1.98E+03	2.99	110.76	125.7	9.00E-01	2197.04
	Co UJ	2000	87.5	8.00E-01	3.50E+00	3.54E+00	3.52E+00	1.03	237.53	86.4	8.00E-01	4.40
	Cu J	1000	88.6	4.00E-01	8.20E+00	7.54E+00	7.87E+00	8.41	110.76	89.5	4.00E-01	19.67
	Fe J	1000	103.9	4.30E+00	1.60E+04	1.55E+04	1.57E+04	3.13	110.76	-265.7	1.00E+00	15724.0
	Pb J	1000	88.3	6.20E+00	1.15E+02	1.14E+02	1.14E+02	0.90	110.76	95.1	6.20E+00	18.45
	Mg J	1000	96.2	9.68E+00	2.27E+02	2.10E+02	2.19E+02	8.00	110.76	107.3	3.00E-01	728.97
	Mn J	1000	84.9	3.32E-01	2.76E+03	2.65E+03	2.71E+03	4.17	110.76	2304.2	2.00E-01	13540.1
	Ni J	1000	89.6	1.70E+00	8.40E+01	9.61E+01	9.01E+01	13.48	110.76	99.0	1.70E+00	52.97
	K J	1000	108.6	1.12E+00	1.08E+03	1.02E+03	1.05E+03	5.72	110.76	157.1	1.12E+01	93.79
	Se UJ	1000	73.6	7.40E+00	1.01E+01	1.12E+01	1.06E+01	10.80	110.76	83.3	7.60E+00	1.40
	Ag UJ	1000	97.1	5.00E-01	1.32E+00	7.89E-01	1.05E+00	50.08	110.76	49.5	5.00E-01	2.10
	Na J	2000	119.2	3.85E-01	3.29E+04	3.10E+04	3.20E+04	5.94	237.53	610.8	3.10E+00	10312.9
	V J	2000	89.6	5.00E-01	1.88E+01	1.23E+01	1.55E+01	41.64	237.53	90.7	5.00E-01	31.00
	Zn UJ	2000	88.6	9.35E+00	1.95E+01	1.97E+01	1.96E+01	1.40	237.53	88.8	3.00E-01	65.37
	Bi J	1000	7.5	-4.97E-01	3.34E+04	3.21E+04	3.28E+04	4.06	110.76	102.8	7.50E+00	4370.75
	B UJ	1000	75.2	1.63E+00	7.94E-01	8.85E-01	8.39E-01	10.88	110.76	63.8	4.00E-01	1.40
	Ce UJ	1000	104.3	1.01E-01	4.92E-01	4.47E-01	4.70E-01	9.60	110.76	109.4	1.01E+01	4.65
	La J	1000	96.2	1.40E+00	5.12E+03	4.91E+03	5.02E+03	4.21	110.76	86.1	1.40E+00	3584.18
	P J	2000	97.6	2.17E-01	9.56E+03	9.04E+03	9.30E+03	5.50	237.53	33.3	5.80E+00	1603.33
	Si J	2000	46.4	9.93E+00	3.81E+02	5.34E+02	4.57E+02	33.47	237.53	154.9	1.30E+00	351.61
	Sr J	2000	86.9	3.62E-01	3.20E+02	3.07E+02	3.14E+02	4.20	237.53	87.8	3.00E-01	1045.27
	S J	1000	120.2	1.32E-01	1.07E+03	1.02E+03	1.04E+03	4.42	110.76	100.9	2.70E+00	386.18
	Sn UJ	1000	94.0	6.95E+00	1.51E+01	1.56E+01	1.53E+01	3.00	110.76	83.0	1.60E+00	9.58
	Ti UJ	1000	89.8	4.00E-01	1.26E+00	3.08E+00	2.17E+00	84.01	110.76	80.8	4.00E-01	5.43
	Zr UJ	2000	86.9	8.00E-01	1.06E+00	1.18E+00	1.12E+00	10.88	237.53	60.9		—

	Analyte I# 405	LMCS Std (%)	PREP BLK (uCi/g)	Result #1 (uCi/g)	Result #2 (uCi/g)	Average (uCi/g)	RPD %	Spike % Rec	DET LIM (uCi/g)	Ratio R/DL
RAD-Acid	TA	108.1	<1.76E-3	4.61E-01 J	5.28E-01	4.98E-01	13.03	185.6	1.58E-03	315.19
	I# 405									
GEA	Cs-137	99.2	<7.5E-5	9.10E-02	8.60E-02	8.85E-02	5.63	NA	7.30E-05	1180.0
	Eu-154	NA	<1.91E-4	<3.1E-4	<3.1E-4	NA	NA	NA	2.40E-04	NA
	Eu-155	NA	<1.16E-4	<5.2E-4	<5.2E-4	NA	NA	NA	1.19E-04	NA
	Am-241	NA	<1.25E-4	2.10E-02	2.00E-02	2.05E-02	4.88	NA	2.26E-03	8.99
	Co-60	84.5	<7.6E-5	<9.1E-5	<1.1E-4	NA	NA	NA	8.15E-05	NA

T-111 Homogenization Analyses For Core 33

Segment 7H-1

	Analyte	LMCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio
18 408		ug/g	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/g)	% Rec	(ug/g)	B/DL
ICP-Acid	Al	1000	114 4	7 05E-01	1 48E-02	8 55E-02	1 62E-02	7 99	118 76	137 7	2 40E-00	67 40
	Sb	1000	96 9	1 77E-01	2 48E-01	2 13E-01	2 41E-01	22 07	118 76	91 7	1 77E-01	1 34
	As	1000	93 5	3 00E-00	4 55E-00	3 61E-00	4 08E-00	23 07	167 76	93 8	3 00E-00	1 34
	Ba	2000	90 4	3 51E-01	3 05E-01	2 46E-01	2 70E-01	10 04	237 53	88 3	3 00E-01	90 01
	Be	2000	89 9	1 00E-01	1 51E-01	6 30E-01	1 34E-01	22 79	237 53	84 9	1 00E-01	1 34
	Cd	2000	91 5	4 00E-01	3 71E-00	3 38E-00	3 54E-00	10 23	237 53	81 4	4 00E-01	8 91
	Ca	2000	138 0	4 09E-01	1 08E-03	1 04E-03	1 06E-03	4 48	237 53	147 2	4 40E-00	240 99
	Cr	1000	97 5	9 00E-01	3 52E-03	2 45E-03	2 48E-03	3 65	118 76	125 7	9 00E-01	2739 59
	Co	2000	92 9	8 00E-01	3 05E-00	2 47E-00	2 76E-00	21 19	237 53	84 4	8 00E-01	3 45
	Cu	1000	92 2	4 00E-01	7 36E-00	7 01E-00	7 15E-00	2 93	118 76	83 5	4 00E-01	17 89
	Fe	1000	99 9	5 79E-00	1 03E-04	6 76E-04	5 79E-04	3 65	118 76	-245 7	1 00E-00	67947 8
	Pb	1000	92 8	6 20E-00	1 20E-01	1 08E-01	1 19E-02	2 20	118 76	95 1	6 20E-00	19 20
	Mg	1000	97 8	3 10E-00	2 06E-02	2 01E-02	2 06E-02	0 33	118 76	107 3	3 00E-01	685 68
	Mn	1000	89 5	3 00E-01	4 18E-03	4 06E-03	4 12E-03	2 82	118 76	2384 2	3 00E-01	20603 2
	Ni	1000	93 3	1 70E-00	7 06E-01	6 68E-01	6 98E-01	2 80	118 76	93 8	1 70E-00	41 04
	K	1000	104 3	1 13E-01	6 91E-02	6 84E-02	6 88E-02	1 03	118 76	137 1	1 12E-01	61 42
	Si	1000	80 0	7 60E-00	1 15E-01	9 16E-00	1 03E-01	22 83	118 76	81 3	7 60E-00	1 34
	Ag	1000	101 2	3 00E-01	1 46E-00	1 64E-00	1 55E-00	11 28	118 76	49 3	3 00E-01	3 10
	Na	2000	127 9	6 41E-01	3 61E-04	3 55E-04	3 58E-04	1 63	237 53	610 8	3 10E-00	11554 9
	V	2000	94 6	3 00E-01	3 23E-00	4 11E-00	4 68E-00	24 50	237 53	80 7	3 00E-01	9 34
	Zn	2000	92 7	1 32E-00	2 32E-01	2 30E-01	2 31E-01	0 94	237 53	88 8	3 00E-01	77 00
	Bi	1000	7 8	-4 82E-01	3 47E-04	3 40E-04	3 43E-04	1 93	118 76	102 8	7 50E-00	4576 23
	B	1000	73 4	2 25E-00	9 09E-01	7 23E-01	8 16E-01	22 82	118 76	63 8	6 00E-01	1 34
	Ca	1000	108 3	1 01E-01	3 66E-01	3 42E-01	3 54E-01	12 13	118 76	109 4	1 01E-01	3 60
	La	1000	100 4	1 40E-00	4 01E-03	4 01E-03	4 88E-03	2 98	118 76	86 1	1 40E-00	3487 03
	P	2000	89 6	2 37E-01	1 22E-04	1 20E-04	1 21E-04	1 23	237 53	53 3	3 80E-00	2089 57
	Si	2000	36 6	1 59E-01	4 23E-02	4 04E-02	4 13E-02	4 51	237 53	154 9	1 30E-00	317 81
	Sr	2000	90 4	3 00E-01	6 91E-02	6 20E-02	6 56E-02	49 07	237 53	87 6	3 00E-01	1854 04
	S	1000	113 9	1 69E-01	1 23E-03	1 22E-03	1 22E-03	0 89	118 76	100 9	2 70E-00	453 33
	Sn	1000	97 8	1 68E-01	3 50E-01	3 05E-01	3 22E-01	24 51	118 76	83 8	1 60E-00	33 90
	Ti	1000	94 1	5 51E-01	3 53E-00	3 46E-00	3 50E-00	3 47	118 76	89 8	4 00E-01	6 26
	Zr	2000	90 1	8 00E-01	1 21E-00	9 64E-01	1 09E-00	22 81	237 53	60 9		--

	Analyte	LMCS Std	PREP BLK	Result #1	Result #2	Average	RPD	Spike	DET LIM	Ratio
	18 408	(%)	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	%	% Rec	(uCi/g)	B/DL
RAD-Acid	TA	94 1	<6 66E-4	3 05E-01	3 28E-01	3 17E-01	7 27	124 5	6 66E-04	475 23
	18 408									
GEA	Cs-137	102 0	4 30E-04	3 34E-01	3 30E-01	3 32E-01	1 72	NA	7 50E-05	309 33
	Eu-154	NA	<2 1E-4	<3 6E-4	<2 9E-4	NA	NA	NA	2 40E-04	NA
	Eu-155	NA	<1 3E-4	<3 3E-4	<2 6E-4	NA	NA	NA	1 19E-04	NA
	Am-241	NA	<3 3E-4	1 36E-01	1 36E-01	1 36E-01	0 00	NA	2 28E-04	59 65
	Co-60	102 0	<3 3E-5	4 43E-04	<8 3E-5	NA	NA	NA	8 13E-05	NA

T-111 Housequalified Analyses For Core 33

Segment TH-1

Analyte	LMICS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spike	DUP LDL	Blank
Id 409		Std	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/g)	(ug/g)	(ug/g)
ICP-AES	Std	Rec								
Al	1000	114	7.03E-01	1.70E-02	1.69E-02	1.69E-02	0.41	110.76	137.7	2.40E-00
Si	1000	94	1.77E-01	3.66E-01	3.77E-01	3.71E-01	27.40	117.76	91.7	1.77E-01
As	1000	92	1.00E-00	4.90E-00	4.70E-00	4.80E-00	4.16	117.76	93.0	3.00E-00
Ba	2000	90	3.31E-01	3.40E-01	3.46E-01	3.43E-01	3.43	237.53	66.3	3.00E-00
Be	2000	89	1.00E-01	1.63E-01	1.57E-01	1.60E-01	4.19	237.53	64.9	1.00E-00
Ca	2000	91	4.00E-01	3.91E-00	3.80E-00	3.70E-00	10.19	237.53	81.4	4.00E-00
Cd	2000	136	4.09E-01	4.04E-01	3.97E-01	3.23E-01	33.37	237.53	167.3	4.00E-00
Co	1000	97	9.00E-01	3.32E-01	3.31E-01	3.33E-01	1.27	118.76	123.7	9.00E-01
Cr	1000	92	4.00E-01	3.42E-00	3.41E-00	3.42E-00	32.32	237.53	66.4	8.00E-01
Cu	1000	93	3.73E-00	7.95E-00	7.63E-00	7.60E-00	1.34	118.76	63.5	4.00E-01
Fe	1000	99	1.00E-01	1.01E-01	1.03E-01	1.02E-01	1.01	118.76	-343.7	1.00E-00
K	1000	92	6.30E-00	1.35E-01	1.22E-01	1.24E-01	2.61	118.76	95.1	6.30E-00
Mg	1000	97	3.10E-00	2.01E-01	2.10E-01	2.07E-01	1.16	118.76	107.3	3.00E-01
Mn	1000	89	3.00E-01	4.17E-01	4.23E-01	4.20E-01	1.23	118.76	2346.3	3.00E-01
Mo	1000	91	1.70E-00	7.04E-01	7.18E-01	7.11E-01	1.73	118.76	95.0	1.70E-00
Ni	1000	104	1.11E-01	6.81E-02	6.81E-02	6.82E-02	0.24	118.76	457.1	1.11E-01
Na	1000	80	7.40E-00	1.19E-01	1.27E-01	1.23E-01	4.16	118.76	81.3	7.40E-00
Pb	1000	101	3.00E-01	3.00E-00	2.99E-00	2.99E-00	63.18	118.76	49.5	3.00E-01
Si	3000	127	6.41E-01	3.46E-04	3.61E-04	3.62E-04	0.00	237.53	410.0	3.10E-00
V	3000	94	3.00E-01	4.19E-00	4.07E-00	4.08E-00	12.36	237.53	90.7	3.00E-01
Zn	3000	92	1.32E-00	3.15E-01	3.04E-01	3.09E-01	23.73	237.53	66.0	3.00E-01
Mi	1000	73	-4.02E-01	3.10E-04	3.30E-04	3.20E-04	0.21	118.76	102.0	3.30E-00
B	1000	114	3.25E-00	9.80E-01	9.40E-01	9.40E-01	4.16	118.76	63.0	6.00E-01
Ca	1000	108	1.01E-01	3.31E-01	3.27E-01	3.30E-01	1.66	118.76	109.4	1.01E-01
La	1000	100	1.40E-00	4.03E-01	4.09E-01	4.06E-01	0.73	118.76	66.1	1.40E-00
P	2000	99	3.37E-01	2.14E-01	1.31E-01	1.72E-01	2.37	237.53	53.3	3.00E-01
Si	2000	34	1.59E-01	3.18E-02	4.91E-02	4.05E-02	13.02	237.53	154.9	1.30E-00
Sr	2000	90	3.00E-01	3.21E-02	3.44E-02	3.33E-02	6.70	237.53	87.8	3.00E-01
Ti	1000	113	1.69E-01	1.24E-01	1.34E-01	1.29E-01	0.47	118.76	100.9	3.70E-00
Va	1000	97	1.68E-01	3.70E-01	3.02E-01	2.86E-01	3.19	118.76	83.0	1.60E-00
W	1000	94	5.31E-01	4.49E-00	4.31E-00	4.41E-00	91.64	118.76	89.0	4.00E-01
Zr	2000	90	6.00E-01	1.31E-00	1.25E-00	1.28E-00	4.00	237.53	60.9	--

Analyte	LMICS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spike	DUP LDL	Blank
Id 409		Std	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/g)	(ug/g)	(ug/g)
RAD-AxId	Tx	94.1	<6.64E-4	3.19E-01	4.41E-01	3.81E-01	33.64	124.3	6.46E-04	5.73E-03
	Id 409									
OEA	Cs-137	102.0	4.30E-04	2.41E-02	2.39E-02	2.39E-02	3.93	NA	7.30E-05	314.67
	Eu-154	NA	<2.1E-4	<3.0E-4	<4.1E-4	NA	NA	NA	2.40E-04	NA
	Eu-155	NA	<2.1E-4	<3.0E-4	<4.1E-4	NA	NA	NA	1.19E-04	NA
	Am-241	NA	<2.1E-4	1.61E-02	1.31E-02	1.34E-02	7.35	NA	2.21E-04	19.65
	Co-60	102.0	<2.1E-4	5.80E-04	<3.4E-4	<4.1E-4	NA	NA	6.13E-05	NA

T-111 Homogenization Analyses For Core 33

Segment 94-1

Analyte	LMCS Std		PREP BLK	Blank #1	Blank #2	Average	RPD	Spike	Spike Std	DET LIM	Blank
	Std (mg/l)	% Rec	(mg/l)	(mg/l)	(mg/l)	(mg/l)	%	% Rec	(mg/l)	(mg/l)	mg/DL
ICP-AES	1000	114 4	7 01E-01	1 20E-02	1 13E-02	1 31E-02	13 91	110 76	137 7	1 40E-00	50 31
Sb	1000	96 8	1 77E-01	3 11E-02	3 11E-02	3 62E-01	77 19	110 76	91 7	1 77E-01	1 43
As	1000	92 3	3 00E-00	3 90E-00	3 61E-00	3 76E-00	7 50	117 76	93 6	3 00E-00	1 33
Ba	3000	90 4	3 51E-01	3 51E-02	3 51E-02	3 51E-02	0 39	337 33	88 3	3 00E-01	638 31
Be	1000	89 8	1 00E-01	1 30E-01	1 30E-01	1 25E-01	7 51	337 33	84 9	1 00E-01	1 33
Cd	3000	91 3	4 00E-01	3 21E-00	3 17E-00	3 19E-00	1 13	337 33	81 4	4 00E-01	7 00
Co	3000	130 3	4 09E-01	3 92E-02	3 99E-02	3 96E-02	1 44	337 33	147 3	4 00E-00	216 02
Cr	1000	97 9	9 00E-01	3 02E-02	3 09E-02	3 01E-02	1 24	110 76	125 7	9 00E-01	2229 29
Cu	3000	92 2	8 00E-01	3 41E-00	3 51E-00	3 46E-00	2 49	337 33	86 4	8 00E-01	3 16
Fe	1000	99 7	3 73E-00	1 46E-04	1 45E-04	1 45E-04	1 96	110 76	-343 7	1 00E-00	16418 7
Pb	1000	92 8	6 30E-00	1 41E-02	1 34E-02	1 38E-02	4 01	110 76	95 1	6 30E-00	21 31
Mg	1000	97 1	3 10E-00	3 31E-02	3 32E-02	3 32E-02	1 03	110 76	107 3	3 00E-01	730 23
Mn	1000	89 3	3 00E-01	4 61E-01	4 61E-01	4 61E-01	0 07	110 76	2306 3	3 00E-01	23231 7
Ni	1000	93 3	1 70E-00	8 81E-02	(1 74E-01	8 80E-01	1 01	110 76	93 8	1 70E-00	51 79
K	1000	104 3	1 12E-01	4 91E-02	(1 74E-02	4 80E-02	1 01	110 76	137 1	1 12E-01	61 86
Na	1000	80 8	7 40E-00	8 07E-00	(1 16E-00	9 51E-00	7 36	110 76	81 3	7 40E-00	1 23
Al	1000	101 3	5 00E-01	1 24E-00	(1 31E-00	1 24E-00	0 04	110 76	69 5	5 00E-01	1 49
Mo	3000	117 9	6 41E-01	4 07E-04	(1 02E-04	4 04E-04	1 13	337 33	610 6	3 10E-00	1304 1
V	3000	84 4	5 00E-01	1 30E-00	(1 17E-00	1 24E-00	12 10	337 33	90 7	5 00E-01	11 34
Zn	3000	92 7	1 32E-00	1 27E-01	(1 34E-01	1 31E-01	3 50	337 33	84 6	5 00E-01	77 15
B	1000	79 4	3 23E-00	3 39E-01	3 32E-01	3 51E-01	7 50	110 76	61 8	4 00E-01	1 25
Ca	1000	108 3	1 01E-01	4 91E-01	4 34E-01	4 34E-01	1 09	110 76	109 4	1 01E-01	4 29
La	1000	100 4	1 40E-00	4 23E-03	4 21E-03	4 21E-03	0 44	110 76	84 1	1 40E-00	3024 30
P	3000	99 6	3 37E-01	1 34E-04	1 44E-04	1 51E-04	6 20	337 33	53 3	8 40E-00	2404 34
Si	3000	34 6	1 39E-01	5 08E-02	4 49E-02	5 10E-02	24 80	337 33	154 9	1 30E-00	390 76
Sr	3000	90 4	3 00E-01	3 79E-02	3 73E-02	3 77E-02	1 10	337 33	87 0	3 00E-01	1237 77
B	1000	113 9	1 69E-01	1 46E-01	1 41E-01	1 44E-01	3 13	110 76	100 9	3 30E-00	512 01
Sn	1000	97 9	1 69E-01	3 14E-01	3 19E-01	3 01E-01	12 34	110 76	83 8	1 60E-00	13 39
Ti	1000	84 1	5 91E-01	3 27E-00	3 00E-00	3 13E-00	8 77	110 76	89 8	6 00E-01	7 03
Zr	3000	90 3	8 00E-01	1 01E-00	9 41E-01	1 00E-00	7 50	337 33	60 8	—	
READ-AES	TA	94 1	<6 66E-4	3 75E-01	3 31E-01	3 35E-01	15 69	124 5	6 66E-04	302 80	
	10 410										
DEA	Cs-137	102 0	4 30E-04	1 13E-02	1 31E-02	1 81E-02	0 74	NA	3 30E-01	139 33	
	Eu-154	NA	<2 1E-4	<2 81E-4	4 41E-04	1 HA	NA	NA	1 40E-04	NA	
	Eu-155	NA	<1 3E-4	<2 82E-4	<2 82E-4	1 HA	NA	NA	1 19E-04	NA	
	Am-241	NA	<2 3E-4	5 06E-02	4 90E-02	5 02E-02	1 59	NA	3 28E-04	230 18	
	Co-60	102 0	<2 3E-5	<9 1E-5	<0 01E-5	NA	NA	NA	6 15E-01	NA	

T-111 Unweighted Low Analyte Pm Core 31

Analyte	LABCS 514		FREP BLK	Result #1	Result #2	Average	RPD	Spike	DET LIM	Ratio
18-411	4444	B Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	B	Rec (ug/g)	(ug/g)	R/DL
Al	1000	114	7.03E-01	1.16E-02	1.24E-02	121.3	6.40	118.76	1.37E-02	50.32
Sb	1000	94.9	1.77E-01	2.01E-01	2.39E-01	21.70	14.43	118.76	1.77E-01	1.33
As	1000	93.5	3.00E-00	3.41E-00	3.93E-00	3.68	14.43	117.76	3.00E-00	1.23
Ba	3000	90.6	3.31E-01	3.38E-02	3.45E-02	241.47	3.15	237.53	3.00E-01	1104.99
Be	3000	89.9	1.00E-01	1.14E-01	1.32E-01	0.12	14.40	237.53	1.00E-01	1.33
Cd	3000	91.3	4.00E-01	3.42E-00	3.81E-00	3.61	10.43	237.53	4.00E-01	9.05
Ca	3000	1138.3	4.09E-01	3.24E-01	3.77E-02	930.63	5.44	237.53	4.40E-00	3140.01
Cr	1000	97.3	9.00E-01	1.96E-01	3.05E-01	3007.31	4.07	118.76	9.00E-01	23340.23
Co	3000	97.0	8.00E-01	3.42E-00	3.69E-00	3.54	10.33	237.53	8.00E-01	3.19
Cu	1000	99.2	4.00E-01	3.06E-00	3.34E-00	3.30	3.44	118.76	4.00E-01	17.99
Fe	1000	99.7	3.71E-00	1.64E-04	1.71E-04	16033.27	3.05	118.76	-343.7	1.00E-00
Pb	1000	97.6	6.30E-00	1.34E-02	1.42E-02	138.10	6.06	118.76	6.30E-00	33.27
Mg	1000	97.1	3.10E-00	3.19E-02	3.34E-02	336.58	3.14	118.76	3.00E-01	7116.59
Mn	1000	89.3	3.00E-01	4.47E-03	4.64E-03	4134.03	3.76	118.76	3.00E-01	22790.3
Ni	1000	93.5	1.70E-00	6.44E-01	6.45E-01	65.44	3.92	118.76	1.70E-00	90.24
K	1000	104.5	1.12E-01	4.79E-02	4.97E-02	488.13	3.64	118.76	1.12E-01	43.58
Se	1000	80.6	7.40E-00	8.44E-00	8.00E-01	9.32	14.63	118.76	7.40E-00	1.33
Ag	1000	101.2	3.00E-01	3.24E-00	3.34E-00	1.30	9.15	118.76	3.00E-01	3.60
Na	1000	127.9	6.41E-01	4.01E-04	4.18E-04	41049.94	3.16	237.53	3.10E-00	13241.9
V	3000	94.4	3.00E-01	1.09E-00	1.42E-00	24.01	3.15	237.53	3.00E-01	8.51
Zn	3000	97.3	1.32E-00	3.12E-01	3.31E-01	31.64	4.10	237.53	3.00E-01	102.16
Bi	1000	73.5	-4.02E-01	3.37E-04	3.46E-04	24181.88	3.79	118.76	7.30E-00	3214.25
Ca	1000	108.3	1.01E-01	6.02E-01	7.09E-01	0.74	14.64	118.76	6.00E-01	1.23
Ce	1000	100.4	1.40E-00	4.06E-03	4.21E-03	4133.96	3.68	118.76	1.40E-00	2954.25
Cs	3000	99.6	3.17E-01	1.54E-04	1.57E-04	15578.80	1.09	237.53	3.00E-01	2646.02
Cl	3000	96.6	1.19E-01	3.15E-03	3.39E-03	389.18	3.63	237.53	1.30E-00	2790.30
Sr	3000	90.4	3.00E-01	3.41E-03	3.93E-03	375.47	3.90	237.53	3.00E-01	1251.34
Ti	1000	115.9	1.49E-01	1.13E-01	1.46E-01	1454.66	3.63	118.76	3.70E-00	5390.30
Sn	1000	97.9	1.44E-01	2.14E-01	2.39E-01	21.15	24.30	118.76	1.40E-00	13.22
W	1000	94.1	3.11E-01	1.13E-00	1.30E-00	6.97	6.97	118.76	3.00E-01	31.36
Zr	3000	90.3	6.00E-01	9.09E-01	1.03E-00	0.98	14.63	237.53	6.00E-01	66.9
Sc-111										
RAD-Acid	TA	94.1	<6.46E-4	3.70E-01	3.67E-01	1.30	124.3	6.66E-04	402.70	
QEA	Cs-137	102.0	4.30E-04	1.32E-02	1.39E-02	4.44	NA	7.50E-03	180.00	
	Eu-154	NA	<2.1E-4	<2.47E-4	NA	NA	NA	2.40E-04	NA	
	Eu-155	NA	<2.1E-4	<2.67E-4	NA	NA	NA	1.19E-04	NA	
	Am-241	NA	<2.1E-4	4.91E-02	5.11E-02	3.58	NA	3.31E-04	121.77	
	Co-60	102.0	<2.1E-3	<2.97E-3	<6.94E-3	NA	NA	8.15E-03	NA	

T-111 Homogenization Analyses For Core 33

T-111 Homogenization Summary

Analyte	segment 1 1398 Result #1 (ug/g)	segment 1 1398 Result #2 (ug/g)	segment 1 1399 Result #1 (ug/g)	segment 1 1399 Result #2 (ug/g)	segment 3 1402 Result #1 (ug/g)	segment 3 1402 Result #2 (ug/g)	segment 3 1403 Result #1 (ug/g)	segment 3 1403 Result #2 (ug/g)	segment 5 1404 Result #1 (ug/g)	segment 5 1404 Result #2 (ug/g)	segment 5 1405 Result #1 (ug/g)	segment 5 1405 Result #2 (ug/g)	segment 7 1408 Result #1 (ug/g)	segment 7 1408 Result #2 (ug/g)	segment 7 1409 Result #1 (ug/g)	segment 7 1409 Result #2 (ug/g)	segment 9 1410 Result #1 (ug/g)	segment 9 1410 Result #2 (ug/g)	segment 9 1411 Result #1 (ug/g)	segment 9 1411 Result #2 (ug/g)
Al	398.3	430.3	416.5	411.7	549.3	544.1	529.9	531.9	625.4	645.8	607.8	584.1	160.2	155.5	169.6	160.9	120.2	113.5	116.0	126.5
Sb	20.5	27.8	19.7	20.4	16.9	19.5	25.2	26.4	37.1	43.8	42.9	30.0	26.8	21.1	36.6	27.7	31.1	21.3	20.1	23.3
As	4.0	4.7	4.1	3.5	3.9	3.9	4.3	3.8	4.0	3.6	4.0	4.4	4.5	3.6	4.9	4.7	3.9	3.6	3.4	3.9
Ba	58.1	64.8	61.7	60.2	25.1	24.9	24.6	23.3	181.2	187.9	181.6	173.9	29.5	24.6	24.0	24.6	231.0	232.0	237.5	245.4
Be	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1
Cd	23.0	15.3	14.3	14.1	3.5	2.1	3.0	3.1	2.9	3.0	3.0	3.1	3.7	3.4	3.5	3.9	3.2	3.2	3.4	3.0
Ca	4494.1	5193.3	4728.1	4876.2	1109.0	1164.3	1143.4	1031.6	1280.5	1340.0	1301.6	1290.2	1084.1	1036.6	1064.4	1373.7	952.5	966.1	923.8	977.4
Cr	460.3	512.4	503.0	480.2	1222.9	1202.6	1159.8	1140.8	2030.7	2101.6	2006.9	1947.8	2516.4	2450.5	2516.6	2540.0	2010.8	1993.9	1963.4	2051.0
Co	4.8	4.7	4.6	4.5	3.5	3.4	3.6	3.0	13.1	3.3	3.5	3.5	3.0	2.5	2.5	3.4	2.6	2.4	2.4	2.7
Cu	88.6	89.9	84.3	83.2	6.4	6.5	6.6	5.0	7.6	8.3	8.2	7.5	7.8	7.1	7.6	7.7	7.2	7.7	7.1	7.3
Fe	20589.1	16310.4	15980.4	16202.7	12044.1	11892.5	11401.2	11515.3	16159.3	16749.3	15972.8	15477.0	18292.9	17601.4	18112.9	18309.5	16644.6	16318.9	16408.5	17258.0
Pb	857.3	873.9	954.2	885.5	104.4	113.6	107.9	100.0	106.8	130.1	114.8	113.9	120.4	117.7	125.5	122.2	143.8	135.5	133.9	142.3
Mg	736.2	841.3	802.8	790.3	201.8	201.5	193.2	187.6	219.4	234.1	227.4	209.9	204.0	205.4	203.5	209.8	235.5	222.1	219.2	233.9
Mn	23336.7	23188.7	24064.7	24608.3	3064.0	3017.2	3700.1	3431.5	2791.8	2898.3	2764.4	2651.6	4178.8	4063.5	4171.6	4223.8	4645.9	4642.8	4468.9	4642.2
Ni	221.9	248.5	233.9	229.5	70.1	60.6	66.3	65.8	85.7	89.3	84.0	94.1	70.0	68.8	70.6	71.8	88.5	87.6	84.4	86.5
K	1019.1	1123.7	1117.5	1113.0	1631.7	1636.7	1747.0	1568.2	1057.4	1095.7	1080.5	1020.4	691.4	684.3	681.0	681.9	484.8	475.6	479.2	497.0
Se	12.3	11.9	8.4	8.8	7.3	7.4	10.0	9.9	10.2	9.2	10.1	11.2	11.5	9.2	12.4	11.9	9.0	9.2	8.6	10.0
Ag	423.0	404.3	744.3	384.0	2.1	1.3	1.3	1.5	1.4	1.1	1.3	0.8	1.5	1.6	1.5	3.0	1.2	1.2	1.2	1.4
Na	21078.9	22973.2	23092.3	22811.3	36247.2	36177.7	35589.4	35294.7	31805.1	32875.6	32919.3	31020.4	36118.1	35534.5	36362.4	36072.9	40635.0	40199.6	40233.4	41846.5
V	14.7	16.7	17.1	17.1	30.0	28.5	35.2	28.8	30.5	11.9	18.8	12.3	5.3	4.1	4.4	5.8	1.3	1.0	1.1	1.4
Zn	237.6	284.5	267.0	265.2	15.5	16.4	17.0	15.0	19.6	20.0	19.5	19.7	23.2	23.0	23.5	30.4	22.7	23.6	21.2	22.1
Bi	701.9	763.5	784.2	766.5	24792.0	24611.7	23802.3	23541.9	33331.0	34574.8	33445.8	32115.5	34653.9	33989.8	35027.5	34953.4	24203.7	23810.2	23724.2	24439.6
B	1.0	0.9	0.7	0.7	0.6	0.6	0.9	0.8	0.8	0.7	0.8	0.9	0.8	0.7	1.0	0.9	0.8	0.7	0.7	0.8
Ce	16.3	19.4	15.5	11.6	37.1	36.8	38.3	41.9	46.1	49.5	49.2	44.7	38.6	34.2	33.3	32.7	43.1	43.6	43.4	45.6
La	3.3	3.3	3.0	1.6	4025.1	4003.3	3818.2	3789.4	5153.3	5355.6	5124.4	4911.3	4954.5	4809.2	4926.5	4962.6	4225.1	4243.7	4039.8	4213.1
P	4213.8	4507.3	4279.8	4509.9	4800.5	4777.2	4900.0	4827.6	8764.9	8980.8	8558.8	8039.8	12105.5	12043.5	12333.8	12063.0	15580.5	14632.4	15431.8	15726.0
Si	436.2	434.4	332.2	319.9	371.1	383.3	375.2	385.0	365.4	347.4	380.6	333.6	422.6	404.0	510.4	455.0	387.9	440.8	385.1	393.1
Sr	99.0	109.6	103.8	102.1	177.2	175.7	177.3	167.3	328.8	332.6	320.3	306.9	492.7	419.7	321.5	343.8	370.4	375.2	368.1	387.8
S	750.6	827.5	802.6	801.1	739.3	730.0	720.7	707.5	1058.8	1085.8	1065.7	1019.6	1227.3	1216.4	1237.8	1243.7	1458.9	1414.0	1430.4	1482.9
Sn	26.0	25.5	21.6	18.5	8.2	9.5	12.5	10.8	13.7	15.9	15.1	15.6	25.0	19.5	27.0	26.2	21.4	18.9	18.6	23.7
Ti	69.0	73.7	70.6	69.4	4.9	4.4	0.6	0.5	2.0	2.5	1.3	3.1	3.5	3.5	2.5	6.7	3.3	3.0	3.1	2.9
Zr	1.3	1.3	0.9	0.9	0.8	0.8	1.1	1.0	1.1	1.0	1.1	1.2	1.2	1.0	1.3	1.3	1.0	1.0	0.9	1.1
TA	0.623	0.672	0.670	0.632	0.187	0.205	0.129	0.133	0.551	0.560	0.468	0.528	0.305	0.326	0.319	0.448	0.275	0.235	0.270	0.267
Cs-137	0.406	0.407	0.396	0.400	0.137	0.137	0.145	0.139	0.091	0.086	0.091	0.086	0.023	0.023	0.024	0.023	0.014	0.013	0.013	0.014
Eu-154	0.021	0.022	0.021	0.021	0.001	0.001	0.001	<3.1E-4	<2.2E-4	<2.5E-4	<3.1E-4	<3.1E-4	<4.6E-4	<2.8E-4	<3.3E-4	<3.1E-4	<2.82E-4	0.001	<2.47E-4	<2.47E-4
Eu-155	0.028	0.027	0.027	0.027	0.002	0.002	0.003	0.002	<5.2E-4	<5.2E-4	<5.2E-4	<5.2E-4	<3.5E-4	<2.8E-4	<3.30E-4	<3.20E-4	<2.87E-4	<2.82E-4	<2.67E-4	<2.67E-4
Am-241	0.136	0.136	0.140	0.139	0.014	0.014	0.014	0.014	0.021	0.020	0.021	0.020	0.014	0.014	0.014	0.013	0.058	0.050	0.050	0.051
Co-60	0.006	0.006	0.005	0.005	0.000	<7.3E-5	0.001	0.000	<9.1E-5	<1.1E-4	<9.1E-5	<1.1E-4	0.000	<8.3E-5	0.001	<3.6E-4	<9.8E-5	<8.05E-5	<7.97E-5	<8.94E-5

T111 Homogenization Summary for Core 33

Analyte	Result #1 (ug/g)	Result #2 (ug/g)	average (ug/g)	RPD %	Result #1 (ug/g)	Result #2 (ug/g)	average (ug/g)	RPD %	RPD % average
Al	396 250	430 234	414 236	7 723	416 526	411 693	414 109	1.167	0 036
Sb	28 548	27 830	28 189	2 548	19 647	20 392	20 020	3 620	33 844
As	4 839	4 717	4 778	2 547	4 143	3 456	3 800	18 080	22 807
Ba	58 060	64 810	61 435	10 967	61 714	60 176	60 945	2 523	0 801
Be	0 161	0 157	0 159	2 773	0 111	0 115	0 113	3 714	31 090
Cd	22 989	13 323	18 156	40 018	14 253	14 122	14 187	0 922	28 804
Ca	4494 063	5193 290	4843 676	14 434	4728 149	4876 213	4802 182	3 083	0 660
Cr	440 306	512 362	476 334	16 304	502 833	480 163	491 498	4 634	1 060
Co	4 830	4 740	4 785	1 873	4 633	4 510	4 568	2 531	4 650
Cu	88 578	89 894	89 236	1 475	84 255	83 242	83 748	1 210	4 345
Fe	20180 116	16110 326	18440 741	23 101	15980 423	16202 702	16091 563	1 381	13 654
Pb	817 307	873 044	845 176	12 730	834 192	885 476	859 834	2 431	0 463
Mg	758 221	841 317	799 770	10 572	802 751	790 112	796 446	1 578	0 415
Mn	21536 701	23188 670	22362 686	15 432	24064 447	24608 201	24336 411	2 225	4 087
Ni	231 851	240 483	236 167	11 923	235 840	229 468	232 701	2 784	1 034
K	1019 127	1123 725	1071 426	9 762	1113 907	1112 999	1113 253	0 404	4 009
Se	12 238	11 850	12 104	2 348	8 444	8 736	8 600	3 631	33 847
Ag	422 014	404 344	413 170	4 377	744 331	304 010	344 166	61 846	30 897
Na	21078 897	22973 206	22026 052	8 620	22882 284	23811 301	23346 794	8 154	2 680
V	14 723	16 723	15 723	12 733	17 150	17 060	17 105	0 526	0 419
Zn	257 650	284 510	271 080	9 909	284 880	265 138	264 049	6 685	1 846
Bi	705 858	783 499	744 679	10 709	784 229	764 500	774 364	2 387	4 172
B	0 960	0 843	0 896	2 543	0 847	0 691	0 679	1 609	33 845
Cs	16 290	18 421	17 356	13 312	15 322	11 636	13 579	28 610	27 209
La	2 258	3 206	2 732	34 699	2 874	1 613	2 243	39 335	17 465
P	4315 821	4507 321	4360 571	6 731	4220 804	4509 907	4368 857	6 418	0 213
Si	416 250	434 400	425 325	6 436	312 348	319 925	326 086	3 770	28 691
Sr	98 976	109 377	104 177	10 167	101 937	102 138	102 038	1 747	1 195
S	750 610	837 490	789 060	9 768	802 584	801 108	801 846	0 184	1 607
Sn	24 014	25 327	24 671	1 949	24 608	18 519	20 063	15 397	24 942
Ti	69 995	72 888	71 342	4 318	70 601	69 439	70 020	1 659	1 670
Zr	1 200	1 258	1 229	2 543	0 889	0 922	0 905	3 623	33 844
TA	0 623	0 672	0 648	7 568	0 670	0 632	0 651	3 017	0 339
Cs-137	0 406	0 407	0 407	0 246	0 396	0 400	0 398	1 005	2 113
Eu-154	0 021	0 023	0 022	1 840	0 021	0 021	0 021	1 896	1 838
Eu-155	0 018	0 017	0 018	0 217	0 027	0 027	0 027	1 849	2 765
Am-241	0 116	0 116	0 116	0 000	0 140	0 139	0 140	0 717	2 541
Co-60	0 006	0 006	0 006	1 513	0 005	0 005	0 005	0 565	16 822

T111 Homogenization Summary for Core 33

Analyte	Result #1 (uCi/g)	Result #2 (uCi/g)	Average (uCi/g)	RPD %	Result #1 (uCi/g)	Result #2 (uCi/g)	Average (uCi/g)	RPD %
Co-60	0.000	<7.3E-5	NA	NA	0.001	0.000	0.001	200.000
Am-241	0.014	0.014	0.014	0.000	0.014	0.014	0.014	3.795
Eu-155	0.002	0.002	0.002	0.000	0.003	0.002	0.002	41.973
Eu-154	0.001	0.001	0.001	0.000	0.001	<3.1E-4	NA	NA
Cs-137	0.137	0.137	0.137	0.000	0.145	0.139	0.142	4.225
TA	0.197	0.205	0.201	3.980	0.129	0.133	0.131	3.053	42.169
ZF	0.743	0.783	0.771	3.509	1.140	1.043	1.093	8.460	34.316
TI	4.078	3.991	3.631	170.287	0.570	0.524	0.547	8.451	131.259
SN	8.218	9.321	8.870	14.696	12.468	10.826	11.637	14.234	27.162
S	339.309	329.964	334.636	1.272	730.691	707.504	719.097	1.643	3.035
SR	177.304	175.703	176.503	0.851	173.324	167.344	172.334	3.791	3.362
SI	331.109	303.322	317.216	3.238	323.170	305.002	480.044	30.411	23.999
P	4000.460	4777.229	4738.845	0.405	4800.014	4627.612	4663.813	1.168	1.553
LA	4035.131	4003.343	4014.237	0.549	3818.300	3749.395	3803.397	0.957	3.383
K	37.144	36.839	36.991	0.825	34.343	41.920	40.132	0.914	8.144
B	0.378	0.387	0.380	2.316	0.855	0.785	0.820	0.463	34.318
BI	24702.802	24611.662	24702.232	0.734	23803.261	23561.925	23682.093	1.013	4.217
ZR	15.547	16.370	16.038	6.369	17.003	14.983	15.993	12.434	0.409
V	29.860	28.437	29.708	1.692	33.164	28.791	31.048	10.964	3.268
NA	26347.178	26177.744	26312.462	0.263	25508.401	25296.660	25443.030	1.151	2.979
AL	3.078	1.313	1.695	45.094	1.317	1.334	1.396	10.970	19.360
SC	7.252	7.436	7.344	3.312	10.024	9.048	10.307	0.438	34.321
K	1631.484	1631.727	1631.706	0.003	1746.078	1560.235	1637.603	10.764	1.575
NI	70.038	68.540	69.824	3.117	66.283	65.787	66.048	0.733	4.852
MG	3866.776	3817.161	3841.968	1.291	3700.097	3621.464	3660.780	3.147	4.830
MG	301.802	301.455	301.628	0.172	193.248	187.569	190.409	3.011	5.724
FE	104.377	113.562	108.969	4.430	107.899	99.995	103.947	7.604	4.317
PB	12044.077	11092.914	11568.496	2.266	11601.184	11315.241	11316.229	0.737	3.331
CD	6.433	6.307	6.370	2.139	6.424	5.828	6.126	12.785	3.848
C	3.465	3.337	3.401	3.744	3.423	3.770	3.596	3.698	3.763
C	1232.856	1202.617	1217.736	1.668	1159.768	1140.825	1150.307	1.648	3.264
C	1109.030	1166.914	1134.467	4.665	1163.378	1031.411	1087.395	10.797	4.631
C4	2.265	3.056	3.160	10.478	3.005	3.064	3.034	1.874	6.619
BE	0.093	0.098	0.097	2.464	0.143	0.131	0.137	0.486	34.378
BA	35.076	34.033	35.004	0.574	24.623	23.747	24.170	3.750	3.903
A	3.063	3.935	3.899	3.911	4.274	3.927	4.100	6.458	34.322
SB	16.889	19.456	18.173	14.121	23.314	26.432	25.823	4.718	34.779
AL	349.303	344.127	346.715	0.947	529.677	531.932	530.804	0.307	3.934
Analyte	Result #1 (uCi/g)	Result #2 (uCi/g)	Average (uCi/g)	RPD %	Result #1 (uCi/g)	Result #2 (uCi/g)	Average (uCi/g)	RPD %

T111 Homogenization Summary for Core 33

	segment 5								
Analyte	Result #1 (ug/g)	Result #2 (ug/g)	average (ug/g)	RPD %	Result #1 (ug/g)	Result #2 (ug/g)	average (ug/g)	RPD %	RPD % averages
Al	623 420	646 231	635 329	3 117	607 827	584 070	595.939	3.983	6 398
Sb	37 065	43 938	40 201	15 603	42 944	30 014	36 479	35.446	9.706
As	4 021	3 823	3 922	10 118	3 948	4 425	4 187	10.878	9.334
Ba	181 231	187 930	184 581	3 629	181 537	173 835	177.706	4.334	3.705
Be	0 134	0 121	0 127	10 361	0 132	0 148	0.140	10.865	9.353
Cd	2 892	3 036	2 964	4 862	3 002	3 071	3.037	2.272	2 441
Ca	1289 490	1339 977	1314 234	3 840	1301 564	1290 219	1295 893	0 876	1.443
Cr	2030 715	2101 636	2066 175	3 433	2006 901	1947 799	1977.350	2 989	4 393
Co	13 095	3 341	8 218	118 694	3 499	13 535	8.517	118.029	80.113
Cu	7 607	8 330	7 969	9 076	8 198	7 536	7.867	8.415	8.282
Fe	16159 300	16749 323	16454 312	3 586	15972 805	15476 963	15726.885	3 153	4.554
Pb	106 845	130 144	118 494	19 662	114 906	113 880	114.393	0 897	5 522
Mg	210 387	234 103	226 746	6 491	227 440	209 943	218 692	8 000	3 616
Mn	2798 826	2888 253	2845 039	3 761	2764 479	2651 601	2708 014	4 166	4.935
Ni	85 647	89 347	87 517	4 182	83 983	96 126	90 055	13 484	2 858
K	1057 387	1095 713	1076 550	3 560	1080 510	1020 431	1050.471	5.720	2.452
Se	10 188	9 179	9 683	10 420	10 011	11.209	10.631	10.878	9.333
Ag	1 409	1 122	1 266	22 670	1 316	0.789	1.052	50.076	18.391
Na	31805 141	32875 630	32340 386	3 310	32010 277	31020 412	31969.844	3.940	1.152
V	10 293	11 942	11 120	14 871	10 744	12 308	11.546	41 662	31 197
Zn	19 594	19 979	19 786	1 945	19 474	19.748	19.611	1.398	0 887
Bi	33130 984	34576 818	34053 891	3 071	33445 783	32185 318	32780.647	4.058	3.810
B	0 804	0 725	0 764	10 426	0 794	0 885	0.839	10.877	9 340
Ca	46 129	48 481	47 805	7 013	49 237	44.725	46.981	9.603	1.739
La	5153 255	5355 620	5254 442	3 851	5124 365	4911 341	5017.854	4.245	4 606
P	8764 883	8980 917	8872 900	2 433	9358 831	9039 846	9299.338	3.501	4.693
Si	365 410	347 394	356 402	5 055	380 590	533 595	457.093	33.474	24.755
Sr	321 831	312 599	316 875	3 502	320 291	306 871	313.581	4.280	4.151
S	1051 230	1065 834	1058 532	3 238	1065 731	1019 630	1042.681	4 431	2.449
Sn	13 716	13 926	13 821	1 517	13 093	13 166	13.129	3.085	10 348
Ti	2.004	2.476	2 240	21 075	1 259	3 082	2.171	84 007	3.147
Zr	1.072	0 966	1 019	10 419	1 058	1.180	1.119	10 875	9 330
TA	0 551	0 560	0 556	1 620	0 468	0 528	0.498	12 048	10 916
Co-137	0 091	0 086	0 089	5 650	0 091	0 086	0 089	5.650	0 000
Eu-154	<3 2E-4	<3 3E-4	NA	NA	<3 1E-4	<3 1E-4	NA	NA	NA
Eu-155	<3 2E-4	<3 3E-4	NA	NA	<3 2E-4	<3 2E-4	NA	NA	NA
Am-241	0 021	0 020	0 021	4 878	0 021	0 020	0 021	4 878	0 000
Co-60	<9 1E-5	<1 1E-4	NA	NA	<9 1E-5	<1 1E-4	NA	NA	NA

Table 4-3. Bioassay Results Summary for Core 33

Analyte	Result #1 (ug/g)	Result #2 (ug/g)	average (ug/g)	RPD %	Result #1 (ug/g)	Result #2 (ug/g)	average (ug/g)	RPD %
Al	166 336	155 799	161 161	7.001	169 596	166 063	167 830	2.111
Sb	24 810	21 323	23 072	22 810	22 351	23 743	23 047	6.494
As	4 544	3 613	4 080	22 810	4 902	4 702	4 802	4.161
Ba	29 665	26 503	27 023	19 062	25 959	26 397	26 178	3 630
Be	0 152	0 121	0 136	22 764	0 161	0 137	0 149	4 164
Cd	3 747	3 383	3 565	10 228	3 509	3 664	3 586	4 636
Ca	3516 370	3450 316	3483 434	1 651	3516 355	3546 036	3531 196	1 273
Cr	1004 105	1036 637	1020 371	4 677	1004 449	1032 706	1018 078	2 824
Co	3 747	3 383	3 565	10 228	3 509	3 664	3 586	4 636
Cu	0 152	0 121	0 136	22 764	0 161	0 137	0 149	4 164
Fe	29 665	26 503	27 023	19 062	25 959	26 397	26 178	3 630
Pb	4 544	3 613	4 080	22 810	4 902	4 702	4 802	4.161
Mg	4138 803	4063 457	4130 630	1 829	4123 644	4223 183	4173 328	2 224
Mn	306 040	305 566	305 703	0 328	309 836	306 556	308 196	0 615
Hg	120 336	117 736	119 044	2 205	123 434	122 310	122 872	1 040
Mo	16292 545	17601 616	17946 080	1 651	16112 930	16308 538	16211 234	1 080
Ni	3 240	3 036	3 135	2 932	3 332	3 454	3 393	3 463
P	11 032	3 447	7 240	21 191	3 460	3 430	3 445	0 436
K	2516 370	2450 316	2483 434	1 651	2516 355	2546 036	2531 196	1 273
Se	1004 105	1036 637	1020 371	4 677	1004 449	1032 706	1018 078	2 824
Ag	3 747	3 383	3 565	10 228	3 509	3 664	3 586	4 636
Na	0 152	0 121	0 136	22 764	0 161	0 137	0 149	4 164
Sr	29 665	26 503	27 023	19 062	25 959	26 397	26 178	3 630
Tl	4 544	3 613	4 080	22 810	4 902	4 702	4 802	4.161
Sn	4138 803	4063 457	4130 630	1 829	4123 644	4223 183	4173 328	2 224
Ti	306 040	305 566	305 703	0 328	309 836	306 556	308 196	0 615
W	120 336	117 736	119 044	2 205	123 434	122 310	122 872	1 040
V	16292 545	17601 616	17946 080	1 651	16112 930	16308 538	16211 234	1 080
Zn	3 240	3 036	3 135	2 932	3 332	3 454	3 393	3 463
Zr	11 032	3 447	7 240	21 191	3 460	3 430	3 445	0 436
Y	2516 370	2450 316	2483 434	1 651	2516 355	2546 036	2531 196	1 273
La	1004 105	1036 637	1020 371	4 677	1004 449	1032 706	1018 078	2 824
Ce	3 747	3 383	3 565	10 228	3 509	3 664	3 586	4 636
Pr	0 152	0 121	0 136	22 764	0 161	0 137	0 149	4 164
Nd	29 665	26 503	27 023	19 062	25 959	26 397	26 178	3 630
Sm	4 544	3 613	4 080	22 810	4 902	4 702	4 802	4.161
Eu	4138 803	4063 457	4130 630	1 829	4123 644	4223 183	4173 328	2 224
Gd	306 040	305 566	305 703	0 328	309 836	306 556	308 196	0 615
Tb	120 336	117 736	119 044	2 205	123 434	122 310	122 872	1 040
Dy	16292 545	17601 616	17946 080	1 651	16112 930	16308 538	16211 234	1 080
Ho	3 240	3 036	3 135	2 932	3 332	3 454	3 393	3 463
Er	11 032	3 447	7 240	21 191	3 460	3 430	3 445	0 436
Tm	2516 370	2450 316	2483 434	1 651	2516 355	2546 036	2531 196	1 273
Yb	1004 105	1036 637	1020 371	4 677	1004 449	1032 706	1018 078	2 824
Lu	3 747	3 383	3 565	10 228	3 509	3 664	3 586	4 636
Ta	0 152	0 121	0 136	22 764	0 161	0 137	0 149	4 164
W	29 665	26 503	27 023	19 062	25 959	26 397	26 178	3 630
Re	4 544	3 613	4 080	22 810	4 902	4 702	4 802	4.161
Os	4138 803	4063 457	4130 630	1 829	4123 644	4223 183	4173 328	2 224
Ir	306 040	305 566	305 703	0 328	309 836	306 556	308 196	0 615
Pt	120 336	117 736	119 044	2 205	123 434	122 310	122 872	1 040
Au	16292 545	17601 616	17946 080	1 651	16112 930	16308 538	16211 234	1 080
Hg	3 240	3 036	3 135	2 932	3 332	3 454	3 393	3 463
Tl	11 032	3 447	7 240	21 191	3 460	3 430	3 445	0 436
Pb	2516 370	2450 316	2483 434	1 651	2516 355	2546 036	2531 196	1 273
Bi	1004 105	1036 637	1020 371	4 677	1004 449	1032 706	1018 078	2 824
Th	3 747	3 383	3 565	10 228	3 509	3 664	3 586	4 636
U	0 152	0 121	0 136	22 764	0 161	0 137	0 149	4 164
Np	29 665	26 503	27 023	19 062	25 959	26 397	26 178	3 630
Pu	4 544	3 613	4 080	22 810	4 902	4 702	4 802	4.161
Am-241	4138 803	4063 457	4130 630	1 829	4123 644	4223 183	4173 328	2 224
Cm-242	306 040	305 566	305 703	0 328	309 836	306 556	308 196	0 615
Cm-243/244	120 336	117 736	119 044	2 205	123 434	122 310	122 872	1 040
Cs-137	0 029	0 022			0 024	0 023		
Eu-154	<3 3E-4	<2 9E-4	NA	NA	<3 3E-4	<3 1E-4	NA	NA
Eu-155	<3 5E-4	<3 8E-4	NA	NA	<3 30E-4	<3 19E-4	NA	NA
Am-241	0 014	0 014	0 014	0 000	0 014	0 013	0 014	7 353
Co-60	0 000	<3 3E-5	NA	NA	0 001	<3 4E-4	NA	NA

Analyte	Result #1 (ug/g)	Result #2 (ug/g)	average (ug/g)	RPD %	Result #1 (ug/g)	Result #2 (ug/g)	average (ug/g)	RPD %
Al	130 171	113 307	130 739	13 911	116 042	136 449	131 255	0 599
Sb	31 068	21 323	26 197	37 190	30 114	21 290	31 702	14 434
As	3 896	3 615	3 755	7 499	3 409	3 417	3 678	14 615
Ba	251 003	251 984	251 493	0 391	237 543	245 307	241 447	3 231
Be	0 130	0 122	0 126	7 508	0 134	0 132	0 123	14 683
Cd	3 209	3 178	3 193	1 119	3 117	3 409	3 613	10 830
Ca	952 273	946 330	939 296	1 464	921 012	977 423	930 617	5 440
Cr	3018 815	1993 907	2006 361	1 241	1963 319	2051 023	3007 306	4 346
Co	3 607	3 419	3 513	7 501	3 424	3 464	3 556	10 159
Cu	3 196	3 706	7 451	6 646	3 019	3 317	3 198	3 510
Fe	16464 551	16318 801	16441 726	1 976	16408 503	17337 893	16833 260	3 046
Pb	141 076	135 517	138 296	4 010	133 913	142 288	138 103	6 010
Mg	233 480	232 037	227 749	5 015	239 351	231 874	236 577	3 343
Mn	4645 892	4642 703	4644 336	0 047	4469 865	4642 190	4556 032	3 763
Hg	81 464	87 599	84 043	1 008	84 364	86 617	85 441	3 130
Mo	4641 811	4251 644	4190 228	1 908	4791 089	4971 046	4881 068	4 658
Ni	8 870	9 157	9 313	7 500	10 000	9 310	9 310	14 634
Nb	1 243	1 244	1 243	0 040	1 237	1 248	1 288	9 348
Na	406553 010	401199 628	404127 323	1 126	402353 404	41846 447	41049 936	1 881
V	1 298	1 039	1 169	22 180	1 090	1 088	1 255	26 051
Zn	22 720	23 560	23 140	3 394	21 150	22 128	21 643	4 478
Zr	24303 680	23810 185	24006 938	1 638	23724 154	24638 598	24181 876	3 766
Si	0 779	0 723	0 751	7 496	0 682	0 790	0 736	14 640
Ca	43 143	43 616	43 379	1 090	43 164	45 615	44 488	5 062
La	4235 071	4243 748	4234 410	0 441	4059 825	4212 087	4135 956	3 681
Pb	155 80 525	144 432 382	151 06 459	6 276	154 81 829	153 725 930	153 78 904	1 088
Li	547 870	448 944	518 408	26 798	385 182	393 039	389 096	3 048
Mg	329 592	312 348	321 320	5 098	346 164	362 290	375 467	3 901
K	1458 906	1411 953	1436 430	3 129	1430 447	1402 073	1456 660	3 589
Ag	21 415	18 883	20 149	13 565	18 581	23 743	21 133	24 302
Na	3 270	2 996	3 133	8 768	3 127	3 917	3 022	6 969
Sr	1 039	0 964	1 001	7 499	0 909	1 013	0 961	14 630
Tl	0 235	0 235	0 235	15 686	0 270	0 267	0 269	1 117
Sn	0 014	0 013	0 013	0 743	0 013	0 014	0 014	4 444
Ti	0 031	0 050	<0 050	1 594	0 050	0 051	0 050	0 377
Co-60	<9 8E-5	<0 05E-5	NA	NA	<9 07E-5	<8 94E-5	NA	NA

T-111 Core 33 Composite 1

DATE	Analyte	SHCB 04		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio	mcq	Mat B
10.433		adjust	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/g)	% Rec	(ug/g)	MDL	conc	(g/g)
HCP-Acid	Al	5000	122.30	1.42E-01	J 6.73E-02	6.71E-02	6.72E-02	0.42	57.41	72.10	2.40E-00	196.67		
	Sb	5000	71.90	1.77E-01	UJ 5.15E-01	2.00E-01	3.58E-01	88.3	57.41	23.10	1.77E-01	2.03		
	As	5000	83.30	3.00E-00	UJ 3.50E-00	3.39E-00	3.45E-00	3.06	57.41	60.10	3.00E-00	8.15		
	Ba	10000	92.70	3.00E-01	J 6.70E-01	6.67E-01	6.68E-01	0.45	114.81	98.60	3.00E-01	222.79		
	Be	10000	91.10	1.00E-01	UJ 1.20E-01	1.13E-01	1.17E-01	5.91	114.81	101.70	1.00E-01	1.17		
	Cd	10000	93.10	4.00E-01	J 4.70E-00	4.09E-00	4.40E-00	13.8	114.81	99.90	4.00E-01	10.99		
	Ca	10000	113.70	3.33E-01	J 1.50E-03	1.49E-03	1.49E-03	0.94	114.81	114.30	4.40E-00	339.32	0.05	0.00
	Cr	5000	98.80	8.00E-01	J 2.01E-01	2.01E-01	2.06E-03	1.55	57.41	138.50	8.00E-01	2291.51	0.18	0.00
	Co	10000	93.40	8.00E-01	UJ 3.10E-00	3.11E-00	3.11E-00	1.06	114.81	99.40	8.00E-01	3.91		
	Cu	5000	91.30	6.00E-01	J 1.65E-01	1.64E-01	1.64E-01	0.01	57.41	94.60	6.00E-01	41.12		
	Fe	5000	102.80	5.62E-00	J 3.76E-04	3.74E-04	3.75E-04	0.54	57.41	324.00	5.00E-00	17481.5	0.0	
	Pb	5000	87.40	6.20E-00	J 3.01E-01	3.00E-01	3.01E-01	0.30	57.41	86.40	6.20E-00	32.37		
	Mg	5000	104.50	3.01E-00	J 3.07E-01	3.07E-01	3.01E-01	1.57	57.41	87.60	3.00E-01	1015.36		
	Mo	5000	91.10	2.00E-01	J 6.77E-03	6.63E-03	6.71E-03	1.73	57.41	183.40	2.00E-01	33361.2	0.03	0.00
	Ni	5000	96.00	1.70E-00	J 1.10E-03	1.09E-03	1.10E-03	0.69	57.41	103.30	1.70E-00	64.48		
	K	5000	107.70	1.12E-01	J 1.22E-03	1.21E-03	1.21E-03	0.80	57.41	80.30	1.12E-01	106.65	0.02	
	Se	5000	88.60	7.60E-00	UJ 1.20E-01	8.60E-00	1.03E-01	33.0	57.41	95.90	7.60E-00	8.34		
	Ag	5000	103.40	5.00E-01	J 6.39E-01	6.48E-01	6.43E-01	1.94	57.41	106.00	5.00E-01	84.66	0.1	
	Na	10000	144.00	8.69E-01	J 3.50E-04	3.48E-04	3.50E-04	0.31	114.81	184.60	5.10E-00	11276.3	0.33	0.03
	V	10000	94.10	3.00E-01	J 1.42E-01	1.35E-01	1.39E-01	4.73	114.81	99.20	3.00E-01	27.74		
	Zn	10000	93.70	-3.56E-00	J 6.47E-01	6.36E-01	6.42E-01	3.43	114.81	101.10	3.00E-01	167.21		
	Si	5000	48.80	7.50E-00	J 2.66E-04	2.64E-04	2.65E-04	0.66	57.41	250.70	7.50E-00	1830.80	0.41	0.01
	B	5000	101.30	1.23E-01	UJ 2.96E-01	2.92E-01	2.94E-01	1.41	57.41	58.30	6.00E-01	48.99		
	Ca	5000	97.30	1.01E-01	UJ 3.57E-01	4.00E-01	3.78E-01	11.3	57.41	93.40	1.01E-01	3.73		
	La	5000	93.40	1.40E-00	J 4.67E-03	4.61E-03	4.64E-03	1.31	57.41	140.80	1.40E-00	3315.93	0.10	0.01
	P	10000	98.60	1.22E-01	J 9.73E-03	9.97E-03	9.84E-03	2.31	114.81	289.60	5.90E-00	8699.80	0.25	0.01
	Si	10000	135.20	3.48E-01	J 4.80E-03	5.75E-03	5.28E-03	18.1	114.81	-46.80	1.30E-00	403.91		
	Sr	10000	92.80	3.00E-01	J 3.08E-02	3.01E-02	3.05E-02	2.30	114.81	96.90	3.00E-01	1015.00		
	S	5000	111.30	1.50E-01	J 1.14E-03	1.14E-03	1.14E-03	0.32	57.41	317.40	2.30E-00	422.90	0.11	0.00
	Sn	5000	83.30	3.99E-00	UJ 1.80E-00	1.81E-00	1.81E-00	0.55	57.41	90.90	1.80E-00	1.13		
	Ti	5000	92.90	4.00E-01	J 8.80E-00	8.90E-00	8.90E-00	2.26	57.41	84.10	4.00E-01	22.25		
	Zr	10000	90.30	8.00E-01	UJ 9.20E-01	9.01E-01	9.11E-01	1.64	—	none	—	NA		

T-111 Core 33 Composite 1

Direct/Unkown	Analyte	Std #1	PREP DILN	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	meq	Mat Bal
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	S/DL	loss	(g/g)
DATE 4-16-92	Id 434											
	DSC	EXO	NA	NO EXO	NO EXO	NA	NA	NA	NA	NA		
DATE 4-17-92	Id 436			(S)	(S)	(S)						
	TGA	98 30	NA	8 72E-01	8 10E-01	8 41E-01	5 47	NA	NA	NA		
DATE 4-16-92	Id 433			(S)	(S)	(S)						
% WATER	% WTR	90 70	NA	J 9 57E-01	7 72E-01	7 65E-01	1 96		NA	NA		0 76
DATE	1 47 K)											
HYAA	As	PNL										
	Se	PNL										
CVAA	Hg	101 60	<0 125	J 1 22E-00	1 18E-00	1 20E-00	3 38	83 70	0 125	9 60		
Date 5-19-92	Id 443											
CN-DIL	CN	99 30	<3 00	UJ <0 01	<4 90	NA	NA	100 20	5 00E-00	NA	0 00	
	CoNiFeCN6				NA							

T-111 Core 33 Composite 1

DATE:	Analyte	LMCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio
18 443		added	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/L)	% Rec	(ug/L)	R/DL
ICP-Water	Al	5000	98 70	2 40E-00	J 1 77E-01	1 34E-01	1 55E-01	27 33	1250	101 30	2 40E-00	ERR
	Sb	5000	100 10	1 77E-01	UJ 1 77E-01	1 77E-01	1 77E-01	0 00	1250	107 50	1 77E-01	1 00
	As	5000	98 50	3 00E-00	UJ 2 99E-00	2 99E-00	2 99E-00	0 00	2500	47 50	3 00E-00	1 00
	Ba	10000	99 00	3 00E-01	UJ 7 15E-01	3 78E-01	5 47E-01	61 60	2500	99 30	3 00E-01	1 82
	Be	10000	103 70	1 00E-01	UJ 9 98E-02	9 98E-02	9 98E-02	0 00	2500	100 20	1 00E-01	1 00
	Cd	10000	101 80	4 00E-01	UJ 3 99E-01	3 99E-01	3 99E-01	0 00	2500	100 20	4 00E-01	1 00
	Ca	10000	92 30	3 04E-01	UJ 4 13E-01	7 16E-01	5 64E-01	53 60	2500	91 80	4 40E-00	13 10
	Cr	5000	101 30	9 00E-01	J 2 26E-02	2 22E-02	2 24E-02	1 59	1250	101 00	9 00E-01	248 64
	Co	10000	99 80	8 00E-01	UJ 8 43E-01	7 98E-01	8 21E-01	5 41	2500	99 20	8 00E-01	1 03
	Cu	5000	96 40	4 00E-01	UJ 3 99E-01	3 99E-01	3 99E-01	0 00	1250	97 50	4 00E-01	1 00
	Fe	5000	99 50	1 00E-00	J 1 47E-02	1 16E-02	1 32E-02	23 69	1250	98 50	1 00E-00	131 82
	Pb	5000	98 60	6 20E-00	UJ 6 28E-00	6 19E-00	6 24E-00	1 52	1250	93 70	6 20E-00	1 01
	Mg	5000	101 80	1 70E-00	UJ 4 01E-00	3 60E-00	3 84E-00	13 43	1250	101 60	3 00E-01	12 80
	Mn	5000	96 00	2 00E-01	J 3 04E-01	2 04E-01	2 54E-01	39 43	1250	95 10	2 00E-01	126 95
	Ni	5000	100 80	1 70E-00	UJ 1 70E-00	1 70E-00	1 70E-00	0 00	1250	100 60	1 70E-00	1 00
	K	5000	98 80	1 12E-01	J 7 19E-02	7 04E-02	7 12E-02	2 11	1250	99 30	1 12E-01	63 54
	Se	5000	98 70	7 60E-00	UJ 7 58E-00	7 58E-00	7 58E-00	0 00	1250	98 40	7 60E-00	1 00
	Ag	5000	102 60	3 00E-01	UJ 6 08E-01	4 89E-01	5 48E-01	10 69	1250	102 00	3 00E-01	1 81
	Na	10000	96 90	4 50E-01	J 3 09E-04	3 06E-04	3 08E-04	0 93	2500	80 40	3 10E-00	9926 17
	V	10000	100 90	3 00E-01	UJ 4 99E-01	4 99E-01	4 99E-01	0 00	2500	98 10	3 00E-01	1 00
	Zn	10000	101 50	-3 35E-00	UJ 2 99E-01	2 99E-01	2 99E-01	0 00	2500	98 20	3 00E-01	1 00
	Bi	5000	103 70	7 50E-00	J 2 58E-02	2 03E-02	2 31E-02	21 03	1250	66 60	7 50E-00	30 84
	B	5000	89 10	6 06E-01	J 5 54E-00	5 54E-00	5 54E-00	0 00	1250	87 60	6 00E-01	9 23
	Ce	5000	103 60	1 01E-01	UJ 1 01E-01	1 01E-01	1 01E-01	0 00	1250	107 50	1 01E-01	1 00
	La	—	—	1 40E-00	J 1 55E-01	1 22E-01	1 38E-01	24 07	1250	102 00	1 40E-00	9 87
	P	10000	97 20	5 80E-00	J 3 34E-03	3 26E-03	3 30E-03	1 62	2500	122 80	5 80E-00	913 61
	Si	10000	83 30	1 49E-01	J 6 71E-02	6 60E-02	6 66E-02	0 31	2500	102 40	1 30E-00	514 97
	Sr	10000	99 00	3 00E-01	J 2 38E-00	1 97E-00	2 18E-00	18 96	2500	99 30	3 00E-01	7 26
	S	5000	100 30	2 70E-00	J 1 07E-03	1 05E-03	1 06E-03	1 38	1250	103 00	2 70E-00	392 45
	Sn	5000	96 80	1 60E-00	UJ 1 60E-00	1 60E-00	1 60E-00	0 00	1250	95 80	1 60E-00	1 00
	Ti	5000	102 50	4 00E-01	UJ 3 99E-01	3 99E-01	3 99E-01	0 00	1250	100 00	4 00E-01	1 00
	Zr	10000	103 40	8 00E-01	UJ 7 98E-01	7 98E-01	7 98E-01	0 00	1250	—	—	

T-111 Core 33 Composite 1

	Analyte	Std Rec	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	meq	Net Bal
Date: 4/23/93	Id: 442	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	B/DL	(ions	(g/g)
IC-Water	F	109 80	<1 00E-1	J 1 36E-03	1 47E-03	1 37E-03	15.38	88.10	5.00E-01	136 50	0 07	0 00
	Cl	91 30	<1 00E-1	J 5 63E-03	6 90E-03	6 01E-03	19.63	93.20	1 00E-01	40 10		0 00
	NO3	100 00	<1 00E-2	J 3 61E-04	3 76E-04	3 69E-04	4.07	107.00	1 00E-02	368 50	0 39	0 04
	NO2	96 80	<1 00E-3	J 7 04E-03	8 42E-03	7.73E-03	17.61	87.60	1 00E-02	7.75		0 00
	PO4	93 60	<1 00E-3	J 1 35E-04	1 34E-04	1 34E-04	0.74	93 90	1 00E-02	133.50		0 01
	SO4	94 70	<1 00E-2	J 3 34E-03	3 23E-03	3 29E-03	3 33	82.50	1 00E-02	32.85		0 00
	F ACID ICP/PO4 IC					2 23E-00						
	S ACID ICP/SO4 IC					1 04E-00						
Date:	Id: 442											
Spec-water	NO3	104 60	<5 00E-1	J 8 34E-03	8 72E-03	8 78E-02	3.33	97.80	5 00E-01	17.56		
	NO3 (IC)/NO2 Spec.					11.97						
	NO2 (IC)/NO2 (SPEC)					0.88						
DATE: 5-4-93	Id: 442											
pH	pH	100 70	NA	J 10 04	10 01	10.01	0.10	NA	NA	NA		
DATE: 4-26-93	Id: 441											
NH3-Water	NH3	100 20	<4500	UJ <4500	<4500	NA	NA	97.30	4.50E-03	NA		
DATE: 4-23-93	Id: 442											
TOC-Water	TOC	96 30	<650	UJ 3 00E-03	3 00E-03	3 00E-03	0.00	91 00	3 00E-03	4 00		
	Acetate Eq		8 83E-03								0 17	
DATE: 4-28-93	Id: 426											
TIC-water	CO3	101 10	<300	UJ 8 98E-02	7 49E-01	8 23E-02	18 09	101 20	3 00E-02	1 65	0 01	0 00

T-11.1 Core 33 Composite 1

DATE:	Analyte	LMCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio	mea	Mean
10.470		add (ug/L)	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/L)	% Rec	(ug/g)	B/DL	kms	(ug/g)
ICP-Fusion	Al	5000	81.10	1.20E-01	J 4.83E-02	4.83E-02	4.84E-02	0.44	1250	94.00	1.20E-01	40.30		
	Sb	5000	94.90	8.83E-01	UJ 8.83E-01	1.29E-02	1.00E-02	37.39	1250	85.60	8.83E-01	1.13		
	As	5000	95.10	1.50E-01	UJ 1.50E-01	1.50E-01	1.50E-01	0.20	2500	45.60	1.50E-01	1.00		
	Ba	10000	93.70	1.50E-00	J 6.48E-01	6.80E-01	6.64E-01	1.69	2500	92.80	1.50E-00	43.61		
	Be	10000	87.10	1.06E-01	UJ 5.00E-01	4.99E-01	4.99E-01	0.20	2500	84.20	1.06E-00	0.47		
	Cd	10000	93.00	2.00E-00	UJ 6.06E-00	6.76E-00	6.41E-00	10.49	2500	90.00	2.00E-00	3.21		
	Ca	10000	90.60	2.00E-02	J 1.93E-03	2.50E-03	2.22E-03	25.76	2500	87.20	2.40E-01	9.22		
	Cr	5000	91.70	4.50E-00	J 1.76E-03	1.81E-03	1.79E-03	2.90	1250	93.20	4.50E-00	396.84		
	Co	10000	92.40	4.00E-00	UJ 1.30E-01	1.37E-01	1.33E-01	4.99	2500	90.10	4.00E-00	3.33		
	Cu	5000	93.20	2.25E-00	J 2.26E-01	2.16E-01	2.21E-01	4.87	1250	91.40	2.25E-00	9.84		
	Fe	5000	91.30	2.59E-01	J 1.57E-04	1.62E-04	1.59E-04	3.23	1250	824.90	2.59E-01	614.29		
	Pb	5000	93.40	3.10E-01	J 2.72E-02	2.62E-02	2.67E-02	3.69	1250	86.20	3.10E-01	8.63		
	Mg	5000	91.40	7.75E-00	J 3.58E-02	3.78E-02	3.68E-02	7.55	1250	91.30	7.75E-00	34.39		
	Mn	5000	90.20	1.55E-01	J 6.13E-03	6.29E-03	6.22E-03	2.51	1250	82.50	1.55E-01	401.84		
	Ni	5000	91.70	1.07E-02	J 9.09E-03	9.49E-03	9.29E-03	4.38	1250	84.10	1.07E-02	86.65		
	K	5000	97.60	5.60E-01	UJ 5.60E-01	5.39E-01	5.51E-01	0.20	1250	-1097	5.60E-01	1.00		
	Se	5000	93.90	3.80E-01	UJ 3.80E-01	3.79E-01	3.80E-01	0.20	1250	86.60	3.80E-01	1.00		
	Ag	5000	88.90	2.91E-00	J 4.00E-01	3.89E-01	3.93E-01	2.73	1250	97.80	2.91E-00	10.37		
	Na	10000	97.30	6.34E-02	J 3.36E-04	3.41E-04	3.38E-04	1.48	2500	79.00	6.34E-02	31.39		
	V	10000	92.60	2.50E-00	J 1.69E-01	1.38E-01	1.53E-01	19.80	2500	91.70	2.50E-00	6.13		
	Zn	10000	94.40	1.37E-01	J 1.00E-02	1.10E-02	1.05E-02	9.39	2500	92.40	1.37E-01	7.67		
	Bi	5000	97.30	3.73E-01	J 2.63E-04	2.66E-04	2.65E-04	1.03	1250	83.30	3.73E-01	704.25		
	B	5000	81.30	5.85E-00	UJ 4.32E-00	5.36E-00	4.84E-00	21.37	1250	78.80	5.85E-00	0.83		
	Ca	5000	101.80	5.05E-01	UJ 5.05E-01	5.04E-01	5.04E-01	0.20	1250	103.20	5.05E-01	1.00		
	La	5000	101.10	7.00E-00	J 4.45E-03	4.58E-03	4.51E-03	3.08	1250	84.50	7.00E-00	644.92		
	P	10000	93.80	8.75E-01	J 9.13E-03	8.99E-03	9.07E-03	1.81	2500	93.20	8.75E-01	103.69		
	Si	10000	66.60	7.34E-01	J 5.39E-03	5.32E-03	5.46E-03	2.40	2500	68.50	7.34E-01	74.34	0.39	
	Sr	10000	92.90	4.37E-00	J 2.84E-02	2.97E-02	2.91E-02	4.28	2500	91.90	4.37E-00	66.44		
	S	5000	96.40	1.55E-01	J 1.08E-03	1.08E-03	1.08E-03	0.18	1250	96.70	1.55E-01	79.93		
	Sn	5000	93.50	8.00E-00	UJ 8.00E-00	7.98E-00	7.99E-00	0.20	1250	92.50	8.00E-00	1.00		
	Ti	5000	92.40	2.00E-00	J 2.22E-01	2.25E-01	2.23E-01	1.16	1250	91.10	2.00E-00	11.16		
	Zr	—	—	4.00E-00	UJ 4.00E-00	3.99E-00	4.00E-00	0.20	1250	—	4.00E-00	—		

WHC-SD-WM-QP-021 ADDENDUM 1, REV 0

WHC-EP-0806

T-111 Core 33 Composite 1

			Water ICP/Acid ICP		Water ICP/Fusion ICP		Fusion ICP/Acid ICP	
Charge Bal	Tot Cat	3.56	Cr	0.108	Al	0.032	Al	1.025
	Tot An	3.28	Mn	0.004	Cr	0.125	Fe	0.012
	Cat/An	1.36	Si	1.269	Fe	0.006	Na	0.968
			B	0.928	Mn	0.004	Si	0.920
			Na	0.880	Si	0.009	Si	10.343
Material Balance: oxide model		0.93	Al	0.033	P	0.384	Ti	2.106
			K	0.366	Si	0.123	P	0.920
			P	0.537	Sr	0.007	Sr	0.954

	Analyte	Std dl	PREP Blk	Result #1	Result #2	Average	RPD	Spk Rec	DET LDL	Ratio	meq	Mat Bal
		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	B/DL	Ions	(g/g)
DATE 4-26-93	18.470											
Fluor	U	101.80	< 3.40E-2	J 3.34E-03	3.01E-03	3.18E-03	10.4	66.10	3.40E-02	0.34	0.017	0.00
	U as uCi/g					1.06E-03						
	Analyte	Std dl	Prep Blk	Result #1	Result #2	Average	RPD	Spk Rec	DET LDL	Ratio	Bal.	
		% Rec	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	%	%	(uCi/g)	B/DL	Ch Err	
DATE 4-16-93	18.470											
RAD-Fus.	TA	94.70	<3.30E-3	J 3.76E-01	J 3.78E-01	3.77E-01	0.53	90.80	3.30E-04	711.52	1.40	
	TA/Pu+Am					3.19E+00						
DATE 4-26-93	18.470											
	TB	96.20	<6.13E-3	9.32E-00	9.66E-00	9.59E+00	3.63	94.40	6.13E-03	853.93	1.20	
	TB/Cr-Si					8.81E-01						
DATE 4-27-93	18.470											
OEA	Cs-137	96.00	4.64E-04	1.13E-01	1.15E-01	1.14E-01	2.64	NA	3.70E-04	306.76	1.30	
	Eu-154	NA	<1.02E-3	<1.01E-3	<1.11E-3	NA	NA	NA	1.20E-03	NA	NA	
	Eu-155	NA	<6.85E-4	3.10E-03	2.97E-03	3.07E-03	6.20	NA	3.03E-04	3.15	47.0	
	Am-241	NA	<1.37E-3	3.79E-01	3.93E-02	3.87E-02	4.13	NA	1.14E-03	33.93	0.93	
	Co-60	96.00	<3.85E-4	<3.70E-4	<3.58E-4	NA	NA	NA	4.07E-04		NA	
DATE 5-6-93	18.470											
	PU239/40	93.70	<3.36-3	J 1.29E-01	1.39E-01	1.34E-01	7.46	89.20	3.30E-03	38.79	0.30	
	PU-236	93.70	NA	<1.00E-3	<1.03E-2	NA	NA	93.30	1.00E-02	NA	1.00	

T-111 Core 33 Composite 1

	Analyte	Rad #1 % Rec	Prep Blk (uCi/g)	Result #1 (uCi/g)	Result #2 (uCi/g)	Average (uCi/g)	RPD %	Spk Rec %	DET LIM (uCi/g)	Ratio S/DL	Rel. Ct Err
Date 5/19/93	38.470										
	Am-241	91.90	6.32E-03	J 3.94E-02	3.71E-02	3.82E-02	6.01	84.10	3.84E-03	6.51	10.0
	Cm-244			none detected		NA	NA	0.00		NA	
		Am-241 (DEAV) Am-241 (ALPHA)				1.01E+00					
DATE 6-24-93	38.470										
	NP-237	68.30	8.47E-01	UJ <3.24E-2	<3.24E-2	NA	NA	74.30	3.24E-02	NA	3.60
DATE 6-28-93	38.470										
	TC-99	106.40	1.00E-02	J 1.16E-02	1.12E-02	1.14E-02	3.51	68.90	6.60E-03	3.46	3.60E-00
								69.00			
DATE 6-23-93	38.470										
	I-129	110.30	LOST	UJ <1.44E-2	<1.11E-2	NA	NA	56.40	6.40E-03	NA	
								39.70			

T-111 Core 33 Composite 1

	Analyte	Std #1	Prep Blk	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio		
		% Rec	(uCi/g)	(uCi/g)	(uCi/g)	(uCi/g)	%	%	(uCi/g)	S/DL	Ct Err	
DATE 4-27-92	18.470											
	Sr-90	92.20	<3.13E-3	J 3.62E-00	3.67E-00	3.65E-00	1.37	94.80	3.13E-03	1695	0.60	
								94.70				
DATE 4-24-92	18.462											
	H-3	88.60	<3.13E-4	<3.13E-4 UJ	<3.13E-4	NA	NA	84.20	3.13E-04	NA	0.60	
DATE 4-24-92	18.462											
	C-14	88.90	<3.23E-4	<3.23E-4 UJ	<3.23E-4	NA	NA	97.20	3.23E-04	NA	0.60	
DATE 4-29-92	18.470											
	Sr-79	N/A	<1.40E-4	UA <1.26E-4	<1.23E-4	NA	NA	89.30	1.40E-04	NA	0.30	
								91.20				
	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	TCLP Lim	Result/Lim
		% Rec	(mg/L)	(mg/L)	(mg/L)	(mg/L)	%	%	(mg/L)	S/DL	(mg/L)	
Date:	18.611											
TCLP-ICP	Ag	101.00	3.00E-03	J 2.50E-02	3.47E-02	2.98E-02	32.50	23.80	3.00E-03	3.97	5.00	0.01
	Ba	96.00	3.00E-03	J 2.82E-01	3.02E-02	2.57E-02	35.03	19.40	3.00E-03	8.57	100.00	0.00
	Cd	95.80	4.00E-03	J 3.00E-02	3.50E-02	3.25E-02	54.55	103.50	4.00E-03	8.88	1.00	0.03
	Cr	101.60	9.00E-03	J 7.34E-00	7.37E-00	7.36E-00	0.55	80.10	9.00E-03	818.22	5.00	1.51
	Pb	96.50	6.20E-02	J 8.84E-01	4.72E-01	6.78E-01	60.75	-5.30	6.20E-02	10.93	5.00	0.14
	As	93.60	3.00E-02	J 1.50E-01	1.50E-01	1.50E-01	0.00	—	3.00E-02	5.00	5.00	0.03
	Se	95.50	7.60E-02	J 3.80E-01	3.80E-01	3.80E-01	0.00	—	7.60E-02	5.00	1.00	0.38
Date:	18.608											
TCLP-CVAA	Hg	100.20	<0.100	UJ 3.10E-02	3.00E-02	3.05E-02	3.28	100.70	1.00E-02	3.05	0.20	0.15

DATE:	Analyte	LIMCS Std		PREP BLK	Bench #1	Bench #2	Average	RPD	Spk Add	Spike	DET LDL	Ratio		
10/15/94		Added	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/g)	% Rec	(ug/g)	R/DL		(ug/g)
ICP-AES	Al	50000	122.30	1.42E-01	J 4.04E-02	4.03E-02	4.03E-02	0.30	37.41	73.10	2.40E-00	168.38		
	Sb	3000	71.80	1.77E-01	UJ 2.61E-01	1.91E-01	2.26E-01	31.72	37.41	25.60	1.77E-01	1.28		
	As	3000	83.30	3.00E-00	UJ 3.90E-00	3.23E-00	3.06E-00	18.75	37.41	60.10	3.00E-00	1.02		
	Ba	10000	93.70	3.00E-01	UJ 8.78E-01	8.67E-01	8.73E-01	1.33	816.81	98.60	3.00E-01	291.03		
	Be	10000	97.10	1.00E-01	UJ 1.00E-01	1.08E-01	1.04E-01	7.33	816.81	101.70	1.00E-01	1.04		
	Cd	10000	95.10	9.00E-01	J 3.80E-00	3.64E-00	3.72E-00	4.43	816.81	99.90	9.00E-01	9.29		
	Ca	10000	112.70	3.13E-01	J 1.34E-03	1.35E-03	1.35E-03	0.96	816.81	816.30	6.40E-00	306.01		
	Cr	5000	98.80	9.00E-01	J 2.13E-03	2.16E-03	2.14E-03	1.38	37.41	138.50	9.00E-01	2391.57		
	Co	10000	93.40	6.00E-01	UJ 3.70E-00	3.13E-00	3.91E-00	64.73	816.81	99.60	6.00E-01	3.84		
	Cu	5000	91.30	4.00E-01	J 1.30E-01	1.29E-01	1.30E-01	0.61	37.41	94.60	4.00E-01	32.40		
	Fe	5000	102.80	5.62E-00	J 1.72E-04	1.73E-04	1.73E-04	1.68	37.41	324.00	1.00E-00	17346.0		
	Pb	5000	87.60	6.20E-00	J 1.69E-02	1.67E-02	1.68E-02	1.38	37.41	86.60	6.20E-00	27.07		
	Mg	5000	104.30	3.01E-00	J 2.92E-02	2.86E-02	2.90E-02	1.30	37.41	87.60	3.00E-01	967.03		
	Mn	5000	91.10	2.00E-01	J 6.23E-03	6.32E-03	6.28E-03	1.46	37.41	183.60	2.00E-01	31373.0	0.1	
	Ni	5000	96.00	1.70E-00	J 1.06E-02	1.09E-02	1.08E-02	0.38	37.41	103.30	1.70E-00	63.71		
	K	5000	107.70	1.13E-01	J 1.02E-03	1.02E-03	1.02E-03	0.33	37.41	80.30	1.13E-01	90.93	0	
	Se	5000	88.60	7.60E-00	UJ 7.60E-00	8.18E-00	7.79E-00	10.03	37.41	95.90	7.60E-00	1.03		
	Ag	5000	103.60	5.00E-01	J 3.19E-01	2.81E-01	3.00E-01	12.70	37.41	106.00	5.00E-01	59.99		
	Na	10000	148.00	9.09E-01	J 3.63E-04	3.63E-04	3.63E-04	0.00	816.81	184.60	3.10E-00	11700.3	1.8	0.04
	V	10000	94.10	5.00E-01	J 1.04E-01	9.38E-00	9.99E-00	0.21	816.81	99.20	5.00E-01	19.98		
	Zn	10000	93.70	-3.36E-00	J 3.54E-01	3.43E-01	3.50E-01	2.48	816.81	101.10	5.00E-01	116.33		
	Si	5000	49.80	7.50E-00	J 2.82E-04	2.84E-04	2.84E-04	1.34	37.41	250.70	7.50E-00	3765.33	0.41	0.03
	B	5000	101.50	1.23E-01	UJ 3.23E-01	3.20E-01	3.22E-01	0.80	37.41	58.50	6.00E-01	53.62		
	Ca	5000	97.30	1.01E-01	UJ 3.83E-01	3.28E-01	3.56E-01	17.07	37.41	93.60	1.01E-01	3.53		
	La	5000	93.60	1.40E-00	J 4.84E-03	4.91E-03	4.89E-03	1.53	37.41	140.80	1.40E-00	3491.03	0.11	0.01
	P	10000	96.60	1.22E-01	J 1.14E-04	1.13E-04	1.13E-04	1.36	816.81	288.60	3.80E-00	1053.23	1.10	0.01
	Si	10000	173.20	7.46E-01	UJ 3.96E-01	4.90E-02	3.94E-02	48.66	816.81	-46.80	1.30E-00	302.96		
	Sr	10000	93.80	3.00E-01	J 3.32E-02	3.37E-02	3.34E-02	1.41	816.81	96.90	3.00E-01	3314.33		
	S	5000	111.30	1.56E-01	J 1.22E-03	1.22E-03	1.22E-03	0.00	37.41	117.40	1.70E-00	431.91	0.11	0.00
	Sn	5000	91.20	2.99E-00	UJ 1.50E-00	1.72E-00	1.61E-00	13.80	37.41	90.90	1.60E-00	1.01		
	Ti	5000	92.90	4.00E-01	J 6.50E-00	6.42E-00	6.46E-00	1.27	37.41	96.10	4.00E-01	16.15		
	Zr	10000	90.30	8.00E-01	UJ 1.70E-01	8.61E-01	8.16E-01	11.17	—	none	—	—		

T-111 Core 33 Composite 2

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Sp4 Rec	DET LIM	Ratio	meq	Wet Bal
		S Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	S	S	(ug/g)	B/DL	Sum	(g/g)
	IS 437											
	DSC	EXO	NA	NO EXO	NO EXO	NA	NA	NA	NA	NA		
	IS 437			(S)	(S)	(S)						
	TOA	98 50	NA	8 30E-01	7 86E-01	8 08E-01	5 45	NA	NA	NA		
	IS 423			(S)	(S)	(S)						
S WATER		99 70	NA	J 7 64E-01	7 78E-01	7 71E-01	1 82	NA	NA	NA		0 77
	IS 431											
HYAA	As	PNL										
	Se	PNL										
CVAA	Hg	10 f 60	<1 23E-1	J 1 15E-00	1 02E-00	1 08E+00	11 89	82 70	1 23E-01	1 08		
	IS 446											
CN-Dir	CN	99 50	<3 00E0	UJ <4 61	<4 76	NA	NA	100 20	5 00E+00	NA	0 000	0
	CoNiFeCN6					NA					0 000	0

T-111 Core 33 Composite 2

DATE:	Analyte	LABCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio
14 441		added	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/L)	% Rec	(ug/g)	R/DL
ICP-Water	Al	5000	98 70	2 40E+00	U J 1 02E-01	1 19E-01	1 10E-01	15 54	1250	107 30	2 40E-00	4 59
	Sb	5000	100 10	1 77E-01	U J 1 77E-01	1 77E-01	1 77E-01	0 00	1250	107 50	1 77E-01	1 00
	As	5000	98 30	3 00E-00	U J 3 00E-00	2 99E-00	3 00E+00	0 10	2500	47 50	3 00E+00	1 00
	Be	10000	99 00	3 00E-01	U J 5 01E-01	5 32E-01	5 16E-01	5 97	2500	99 30	3 00E-01	1 72
	Ba	10000	103 70	1 91E-01	U J 9 99E-03	9 91E-03	9 99E-03	0 10	2500	100 20	1 00E-01	1 00
	Cd	10000	101 90	4 00E-01	U J 4 00E-01	3 99E-01	3 99E-01	0 10	2500	100 20	4 00E-01	1 00
	Ca	10000	97 30	3 94E-01	U J 4 13E-01	8 35E-01	6 73E-01	77 04	2500	91 80	4 00E-00	55 35
	Cr	5000	101 30	9 00E-01	J 3 09E-02	2 12E-02	2 11E-02	1 21	1250	102 00	9 00E-01	234 18
	Co	10000	99 80	8 00E-01	U J 7 99E-01	8 50E-01	8 25E-01	6 17	2500	99 20	8 00E-01	1 03
	Cu	5000	96 60	4 00E-01	U J 4 00E-01	3 99E-01	3 99E-01	0 10	1250	97 50	4 00E-01	1 00
	Fe	5000	99 50	1 00E-00	J 1 38E-02	1 60E-02	1 49E-02	1 36	1250	98 50	1 00E-00	139 33
	Pb	5000	98 60	6 20E-00	U J 6 19E-00	6 18E-00	6 19E-00	0 10	1250	93 70	6 20E-00	1 00
	Mg	5000	101 90	1 78E-00	U J 3 72E-00	3 93E-00	3 83E-00	6 03	1250	101 60	3 00E-01	12 76
	Mn	5000	96 00	2 00E-01	J 3 42E-01	3 34E-01	3 38E-01	2 26	1250	95 10	2 00E-01	168 99
	Ni	5000	100 80	1 70E-00	U J 1 70E-00	1 70E-00	1 70E-00	0 10	1250	100 60	1 70E-00	1 00
	K	5000	98 80	1 12E-01	J 6 50E-02	6 47E-02	6 48E-02	0 50	1250	99 50	1 12E-01	57 80
	Se	5000	98 70	7 60E-00	U J 7 59E-00	7 58E-00	7 59E-00	0 10	1250	98 40	7 60E-00	1 00
	Ag	5000	102 60	5 00E-01	U J 4 99E-01	4 99E-01	4 99E-01	0 10	1250	102 00	5 00E-01	1 00
	Na	10000	96 90	4 50E-01	J 3 22E-04	1 18E-04	3 20E-04	0 66	2500	80 40	5 10E-00	10334 3
	V	10000	100 90	5 00E-01	U J 6 16E-01	5 31E-01	5 99E-01	30 69	2500	98 10	5 00E-01	1 60
	Zn	10000	101 30	-5 35E-00	U J 3 00E-01	2 99E-01	3 00E-01	0 10	2500	98 20	5 00E-01	1 00
	Bi	5000	103 70	7 50E-00	J 2 67E-02	2 73E-02	2 70E-02	1 96	1250	96 60	7 50E-00	36 92
	B	5000	89 10	8 06E-01	J 4 06E-00	4 44E-00	4 25E-00	8 89	1250	87 60	8 00E-01	7 08
	Ce	5000	103 60	1 01E-01	U J 1 01E-01	1 01E-01	1 01E-01	0 10	1250	107 50	1 01E-01	1 00
	La	—	—	1 40E-00	J 1 58E-01	1 57E-01	1 58E-01	0 10	1250	102 00	1 40E-00	11 23
	P	10000	97 20	3 80E-00	J 3 74E-03	3 66E-03	3 70E-03	1 34	2500	123 80	3 80E-00	981 21
	Si	10000	83 30	1 49E-01	J 6 18E-03	6 22E-02	6 20E-02	0 58	2500	103 40	1 30E-00	476 94
	Sr	10000	99 00	3 00E-01	J 2 29E-00	2 39E-00	2 34E-00	4 26	2500	90 30	3 00E-01	7 79
	S	5000	100 30	2 70E-00	J 1 14E-03	1 14E-03	1 14E-03	0 41	1250	101 00	2 70E-00	422 81
	Sn	5000	96 80	1 60E-00	U J 1 60E-00	1 60E-00	1 60E-00	0 10	1250	91 80	1 60E-00	1 00
	Ti	5000	102 30	4 00E-01	U J 4 00E-01	3 99E-01	3 99E-01	0 10	1250	100 00	4 00E 01	1 00
	Zr	10000	101 40	5 00E-01	U J 7 99E 01	7 98E-01	7 99E-01	0 10	1250	—	—	

T-111 Core 33 Composite 2

Date 4/23/92	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	meq	Mst Bsl
10 463		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	B/DL	ions	(g/g)
IC-Water	F	109 80	<1 00E+1	J 8 59E-03	8 67E-03	1 63E-03	4 91	81 50	1 00E+01	163 00	0 09	0 00
	Cl	93 20	<1 00E+1	J 4 23E-02	4 40E-02	4 32E-02	3 94	83 20	1 00E+01	43 15		0 00
	NO3	100 00	<1 00E+2	J 4 03E-04	3 96E-04	4 01E-04	1 25	107 00	1 00E-02	400 50	0 65	0 00
	NO2	96 80	<1 00E+2	J 7 04E-02	7 59E-02	7 32E-02	7 32	87 00	1 00E-02	7 32		0 00
	PO4	93 60	<1 00E+2	J 1 50E-04	1 51E-04	1 51E-04	0 66	93 90	1 00E-03	150 50		0 00
	SO4	94 70	<1 00E+2	J 3 52E-03	3 41E-03	3 47E-03	3 17	92 30	1 00E-02	34 65		0 01
	F ACID ICP/PO4 IC					2 31E-00						
	S ACID ICP/SO4 IC					1 04E-00						
Date 4/24/92	10 463											
Spec-Water	NO3	108 60	<5 00E+1	J 8 60E-02	7 74E-02	8 17E-02	10 53	97 80	5 00E-01	16 34	0 02	0 00
	NO3 (IC)/NO3 Spec.					49 02						
	NO2 (IC)/NO2 (SPEC)					0 90						
DATE 5-4-92	10 463											
pH	pH	100 70	NA	J 9 81E-00	9 72E-00	9 77E-00	0 92	NA	NA	NA		
DATE 4-28-92	10 463											
NH3-Water	NH3	100 20	<4500	UJ <4500	<4500	NA	NA	97 30	4500	NA		
DATE 4-23-92	10 463											
TOC-Water	TOC	96 30	<650	UJ 3 00E-03	3 00E-03	3 00E-03	0 00	91 00	500	6 00		
	Acetate Eq		1 47E-04								0 250	0 020
DATE 4-28-92	10 463											
TIC-Water	CO3	101 10	<500	UJ 7 99E-02	1 10E-03	9 50E-02	11 70	102 30	500	1 90	0 032	0 002

DATE:	Analyte	LABCS Std		PREP BLK	Result #1	Result #2	Average	RPD	Spk add	Spike	DET LIM	Ratio	Note
10 4 91		add (ug/L)	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	(ug/L)	% Rec	(ug/g)	B/DL	Num
ICP - Fusion	Al	5000	91 10	1 20E-01	J 4 59E-02	4 59E-02	4 59E-02	0 00	1250	94 00	1 20E-01	38 25	
	Sb	5000	94 90	8 85E-01	UJ 8 85E-01	8 85E-01	8 85E-01	0 00	1250	83 60	8 85E-01	1 00	
	As	5000	93 10	1 50E-01	UJ 1 50E-01	1 50E-01	1 50E-01	0 00	2500	45 60	1 50E-01	1 00	
	Ba	10000	93 70	1 50E-00	J 7 30E-01	7 43E-01	7 37E-01	1 77	2500	92 00	1 50E-00	49 14	
	Be	10000	87 10	1 06E-00	UJ 4 99E-01	5 00E-01	4 99E-01	0 20	2500	84 20	1 06E-00	0 47	
	Cd	10000	93 00	2 00E-00	UJ 7 48E-00	6 84E-00	7 17E-00	8 65	2500	90 00	2 00E-00	3 59	
	Ca	10000	90 60	2 40E-02	J 1 92E-03	2 15E-03	2 03E-03	11 7	2500	87 20	2 40E-02	8 34	
	Cr	5000	93 70	4 50E-00	J 1 82E-03	1 82E-03	1 82E-03	0 00	1250	93 20	4 50E-00	404 16	
	Co	10000	92 40	4 00E-00	UJ 1 48E-01	8 90E-00	1 18E-01	49 3	2500	90 10	4 00E-00	2 96	
	Cu	5000	92 20	2 25E-00	J 2 61E-01	2 30E-01	2 46E-01	12 6	1250	91 40	2 25E-00	10 94	
	Fe	5000	92 50	2 39E-01	J 1 61E-04	1 61E-04	1 61E-04	0 00	1250	1241 90	2 39E-01	621 74	
	Pb	5000	93 40	3 10E-01	J 2 67E-02	2 72E-02	2 69E-02	1 78	1250	84 20	3 10E-01	8 69	
	Mg	5000	93 40	2 75E-00	J 2 69E-02	2 76E-02	2 72E-02	1 84	1250	91 30	2 75E-00	35 06	
	Mn	5000	90 20	1 55E-01	J 6 59E-03	6 59E-03	6 59E-03	0 00	1250	82 50	1 55E-01	4123 63	
	Ni	5000	93 70	1 07E-02	J 1 43E-04	9 81E-03	1 38E-04	97 1	1250	84 10	1 07E-02	112 41	
	K	5000	97 60	3 60E-01	UJ 3 59E-01	3 60E-01	3 59E-01	0 20	1250	-1097	3 60E-01	1 00	
	Se	5000	91 60	3 80E-01	UJ 3 79E-01	3 80E-01	3 80E-01	0 20	1250	86 60	3 80E-01	1 00	
	Ag	5000	88 80	2 91E-00	J 3 74E-01	3 69E-01	3 71E-01	1 47	1250	97 90	2 91E-00	12 77	
	Na	10000	92 30	6 34E-01	J 3 52E-04	3 51E-04	3 52E-04	0 33	2500	79 00	6 34E-02	55 47	
	V	10000	92 60	2 50E-00	J 1 51E-01	1 42E-01	1 47E-01	5 94	2500	91 70	2 50E-00	5 87	
	Zn	10000	94 40	1 37E-01	J 1 19E-02	1 02E-02	1 10E-02	15 4	2500	92 40	1 37E-01	8 04	
	Bi	5000	97 30	3 75E-01	J 2 61E-04	2 73E-04	2 67E-04	4 52	1250	33 30	3 75E-01	701 88	
	B	5000	81 30	5 85E-00	UJ 5 10E-00	4 58E-00	4 84E-00	10 9	1250	78 80	5 85E-00	0 83	
	Ca	5000	101 80	5 05E-01	UJ 5 04E-01	5 03E-01	5 04E-01	0 20	1250	103 20	5 05E-01	1 00	
	La	5000	101 10	7 00E-00	J 4 78E-03	4 84E-03	4 81E-03	1 36	1250	84 50	7 00E-00	687 17	
	P	10000	93 80	8 75E-01	J 9 91E-03	9 91E-03	9 91E-03	0 01	2500	93 20	8 75E-01	113 30	
	Si	10000	69 60	7 39E-01	J 5 41E-03	5 41E-03	5 41E-03	0 04	2500	68 50	7 34E-01	73 69	0130
	Sr	10000	93 90	4 37E-00	J 3 46E-02	2 98E-02	3 17E-02	11 9	2500	91 90	4 37E-00	72 45	
	S	5000	96 40	1 35E-01	J 1 16E-03	1 16E-03	1 16E-03	0 52	1250	96 70	1 35E-01	83 79	
	Se	5000	83 50	8 00E-00	UJ 7 98E-00	8 00E-00	7 99E-00	0 20	1250	92 30	8 00E-00	1 00	
	Ti	5000	92 40	2 00E-00	J 2 31E-01	2 51E-01	2 41E-01	8 62	1250	91 10	2 00E-00	12 05	
	Zr	—	—	4 00E-00	UJ 3 99E-00	4 00E-00	4 00E-00	0 20	—	—	4 00E-00	—	

T-111 Core 33 Composite 2

			Water ICP/Acid ICP		Water ICP/Fusion ICP		Fusion ICP/Acid ICP	
			Cr	0.10	Al	0.024	Al	1.13
Charge Bal	Tot Cat	3.58	Mn	0.01	Cr	0.116	Fe	0.93
	Tot An	2.58	Si	1.57	Fe	0.910	Na	0.97
	Cat/An	1.39	S	0.94	Mo	0.005	Si	0.94
			Na	0.98	Si	0.910	Si	11.74
Material Balance: oxide model		0.96	Al	0.03	P	0.375	Ti	1.73
			K	0.64	Si	0.115	P	0.87
			P	0.50	Sr	0.007	Sr	0.95

Date:4/27/93	Analyte	Std #1	PILEP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	meq	Mat Bal
18.471		% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	B/DL	Limit	(g/g)
Fluor	U	101.00	<3.40E-3	J 1.82E-03	3.07E-03	1.93E-03	12.83	66.10	3.40E-02	3.71	0.016	0.002
	U as uCV/g					6.47E-04						
	Analyte	Std #1	Prep Blk	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	Bal.	
		% Rec	(uCV/g)	(uCV/g)	(uCV/g)	(uCV/g)	%	%	(uCV/g)	B/DL	Cs Est	
DATE:4-26-93	18.471											
ALD-Fus.	TA	94.70	<3.30E-3	J 3.97E-01	3.97E-01	3.97E-01	0.00	80.80	3.30E-04	748.06	1.400	
	TA/Pu-Am					2.03E+00						
DATE:4-26-93	18.471											
	TB	96.20	<6.15E-3	8.95E+00	8.83E+00	8.89E+00	1.33	94.40	6.15E-02	144.53	1.300	
	TB/Cs-Sr					9.14E-01						
DATE:4-27-93	18.471											
OEA	Cs-137	94.00	4.64E-02	1.04E-01	1.03E-01	1.03E-01	0.97	NA	3.70E-04	279.73	1.600	
	Eu-154	NA	<1.01E-3	<9.64E-4	<1.03E-3	NA	NA	NA	1.20E-03	NA	NA	
	Eu-155	NA	<6.83E-4	<1.49E-3	<1.49E-3	NA	NA	NA	8.81E-04	NA	NA	
	Am-241	NA	<1.39E-3	4.61E-02	4.24E-02	4.43E-02	8.56	NA	1.14E-04	388.16	7.800	
	Ce-144	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	Co-60	96.00	<3.83E-4	<3.43E-4	<3.29E-4	NA	NA	NA	4.07E-04	NA	NA	
DATE:5-6-93	18.471											
	PU239/40	78.30	<3.36E-3	J 1.42E-01	1.33E-01	1.47E-01	7.46	84.80	3.30E-03	43.14	0.300	
	PU-238	78.30	<3.36E-3	<1.04E-2	<1.13E-2	NA	NA	76.60	1.60E-01	NA	0.900	

T-111 Core 33 Composite 2

	Analyte	Std #1	PREP BLK	Result #1	Result #2	Average	RPD	Spk Rec	DET LIM	Ratio	Relative
Date 3/19/93	10 471	% Rec	(ug/g)	(ug/g)	(ug/g)	(ug/g)	%	%	(ug/g)	B/DL	% Cl Err
	Am-241	91 90	6 32E-03	J 5 11E-02	4 44E-02	4 78E-02	14 03	89 80	6 00E-03	7 96	9 70
								88 70			
	Cm-244			none detected		NA	NA			NA	
		Am-241 (GEA)/Am-241 (ALPHA)				9 97E-01					
DATE 4-26-93	10 471										
	NP-237	68 20	8 47E-01	UJ < 24E-1	< 24E-1	NA	NA	89 20	3 40E-02	NA	6 60
Date:	10:										
	TC-99	106 60	1 00E-02	J 1 03E-01	1 03E-02	1 04E-02	1 92	87 00	1 60E-03	2 26	5 70
								88 60			
DATE 4-23-93	10 471										
	I-129	119 50	LOST	UJ < 2 17E-2	<1 73E-2	NA	NA	30 70	1 40E-03	NA	
								31 80			
DATE 4-27-93	10 471										
	Sr-90	92 20	< 1 53E-3	J 3 48E-00	3 37E-00	3 43E-00	3 21	95 40	2 15E-03	1593 0	0 60
								94 10			
DATE 4-26-93	10 463										
	H-3	81 40	< 1 5E-4	UJ < 1 5E-4	< 1 5E-4	NA	NA	94 20	3 15E-04	NA	6 30
DATE 4-26-93	10 463										
	C-14	88 90	< 2 5E-4	UJ < 2 5E-4	< 2 5E-4	NA	NA	87 80	3 25E-04	NA	4 20
DATE 4-29-93	10 471										
	Sr-79	N/A	<1 60E-4	U <1 36E-4	<1 29E-4	NA	NA	89 30	1 40E-04	NA	4 50
								87 50			

There were no TCLP analysis required for this core composite sample.

WHC-SD-WM-DP-058
REV. 0-B

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This report consists of pages 1 through 135, plus 3.1-3.3, 4.1, 5.1, 9.1-9.30, 23.1-23.2 and 32.1.

188.5 J/g calculated dry (wt. basis) value compared to average May exotherm values of 280.9 J/g on a calculated dry (wt. basis) value. The exotherm trace obtained in May is less well resolved than the January scan. The exotherms are very broad and not well separated from the water endotherms, so the baselines have been conservatively estimated.

Comparison of the current 222-S data (May 1994), and the original January 1992 data obtained for Core 33 segments 1 and 2 is quite interesting. The original data (Jan.1992) was obtained on a wet sample under air. The January 1994 and current data are on a dried sample as previously described. The wet sample (Jan. 1992), Core 33 segment 1 yielded an average value of 1151 J/g dry (wt. basis), and 2848.5 J/g dry (wt. basis) for segment 2. Both of these values are considerably different from the values obtained on the dried sample either in January or May 1994.

Samples from Core 33 segment 2 were also run by PNL in January 1994, reference 6. Results for Core 2 samples run under nitrogen purge were 942 J/g dry (wt. basis) and 1011 J/g dry (wt. basis) for an average value of 976.5 J/g dry. Sample preparation for the January 1994 samples run by both labs were similar. The PNL sample was vacuum dried at 60 degrees C for 24 hours. At 222-S the sample was vacuum dried (35 torr) at 60 degrees C to a constant weight. The two laboratories used different heating rates for the DSC. The 222-S lab used 10 C per minute, while PNL ran their sample at 5 C per minute. This difference should not effect the magnitude of the exotherm, but may cause a shift in the curve. The instruments used by the laboratories were also different. The instrument used at 222-S is a Mettler M3 balance DSC Model 20 TG-50 , and at PNL a Perkin Elmer Model 2 was used.

Tank 241-T-111 Limited Analysis of Core 33 Segment 2

Introduction

The analyses in this package were performed by the Westinghouse Hanford Company (WHC), under the guidance provided by the Analytical Integration Characterization Program (AICP), refer to references 1, 2, and 3. The analyses presented in this report provides additional information on the energetics previously observed for Tank 241-T-111, reference 4. There were no exotherms that exceeded the safety criteria.

Sample preparation and analyses were performed by the Analytical Services of WHC. Core 33 segment 2 was placed in an oven on 1/10/94 at 1500 with an initial weight of 28.64 grams (gms) and removed on 1/12/94 at 0735 and was stabilized in a hood for 1 hour, the final weight of the sample was 6.82 gms. The dried sample was stored in archive and was retrieved in May to perform this body of work. The specific analyses requested included Differential Scanning Calorimetry (DSC), which was performed under a nitrogen atmosphere on the sample previously dried under vacuum (35mm of Hg) at 60 degrees C. In addition, Thermographic Analysis (TGA) were performed on the dried archive sample. The analyses were performed to the quality assurance protocols reference 7.

Data Evaluation of Tank 241-T-111

Thermogravimetric analysis on the dried samples yielded an average value of 11.2% weight loss interpreted to be water loss. Differential Scanning Calorimetry of 5-10 mg. and 10-20 mg. sample sizes under nitrogen purge were performed. This analysis (May 1994) of Core 33 segment 2 showed consistent low broad exotherms, with no significant differences caused by sample sizes. These results are consistent with previous work performed on Core 33 segment 2 in January 1994, reference 5. The average DSC exotherm value from January was

References:

1. Internal Memo, D. R. Bratzel to J. G. Kristofzski, "Letter of Instruction on Centrifugation of Tank 241-T-111 Samples," dated April 22, 1994. 7E720-94-119 Westinghouse Hanford Company, Richland Wa.

2. Internal Memo, D. R. Bratzel to J. G. Kristofzski, "Letter of Instruction for Tank 241-T-111 Archive Samples, "dated April 29, 1994. 7E720-94-120 Westinghouse Hanford Company, Richland Wa.

3. Internal Memo, D. R. Bratzel to J. G. Kristofzski, "Revised Letter of Instruction for Tank 241-T-111 Archive Samples." dated May 2, 1994. Internal Memo, D. R. Bratzel to J. G. Kristofzski, "Letter of Instruction for Tank 241-T-111 Archive Samples," dated April 29, 1994. 7E720-94-122 Westinghouse Hanford Company, Richland Wa.

4. WHC-SD-WM-DP-024, Rev 0. Tank 241-T-111 Core 31 and Core 33.

5. WHC-SD-WM-DP-058, Rev 0. Tank 241-T-111 Reanalyses of T-111 limited Analysis.

6. Pacific Northwest Laboratories, Tank Waste Characterization Project. Tank 241-T-111 Core 33 Data Report Rev. 0. January 10, 1994. Pacific Northwest Laboratories, Richland Wa.

7. WHC-SD-WM-PLN-047, Appendix A, Core Sample Characterization Quality Assurance Project Plan.

Summary Table for Tank 241-T-111 Core 33 Segment 2, dried archive sample.

Sample Prep.	Analyte	Safety Criteria J/g dry	Std. #1 %	Result #1 J/g	Result #2 J/g	Average J/g	RPD %
			J1667-5511	J1668-5711	J1668-5711		
Direct	DSC	>522 J/g dry	96.0	251.2	269.0	260.1	6.84
			J1667-5511	J1669-5711	J1669-5811		
Direct	DSC	>522 J/g dry	96.0	309.2	287.5	298.4	7.27
			J1667-5511	J1670-5711	1670-5811		
Direct	DSC	>522 J/g dry	96.0	180.2	187.1	183.7	3.76
			J1667-5511	J1671-5711	J1671-5811		
Direct	DSC	>522 J/g dry	96.0	162.7	175.3	168.8	7.46
			J1667-5511	J1672-5711	1672-5811		
Direct	DSC	>522 J/g dry	96.0	336.2	335.9	336.0	0.09
			%	%	%	Average %	
			J1667-5512	J1668-5712	J1668-5812		
Direct	TGA		99.1	11.68	10.06	10.9	14.86
			J1667-5512	J1669-5712	J1669-5812		
Direct	TGA		99.1	10.66	9.90	10.3	7.38
			J1667-5512	J1670-5712	1670-5812		
Direct	TGA		99.1	11.35	11.99	11.7	5.47
			J1667-5512	J1671-5712	J1671-5812		
Direct	TGA		99.1	12.07	12.08	12.075	0.08
			J1667-5512	J1672-5712	J1672-5812		
Direct	TGA		99.1	11.21	11.10	11.15	0.99

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WHC-SD-WM-DP-058 REV. 0-A 5/24/94

Internal Memo

From: Analytical Integration
Phone: 373-3579 R2-18
Date: April 29, 1994
Subject: LETTER OF INSTRUCTION FOR TANK 241-T-111 ARCHIVE SAMPLES

7E720-94-119

To: J. G. Kristofzski T6-06

cc:

H. Babad	R2-78	K. L. Kocher	T6-06
G. S. Barney	T5-12	R. P. Marshall	T6-14
D. B. Bechtold	T6-09	L. M. Sasaki	R2-12
C. DeFigh-Price	R2-31	P. Segall	H4-19
D. B. Engelman	R1-49	B. C. Simpson	R2-12
J. M. Grigsby	H4-62	D. A. Turner	R2-78
C. S. Haller	R2-12	for T. E. Whelan HKA 4/29/94	S1-57
J. M. Kier	T3-01	LMS File/LB	

Reference: Internal Memo, D. R. Bratzel to J. G. Kristofzski, "Letter of Instruction on Centrifugation of Tank 241-T-111 Samples," dated April 22, 1994.

This letter of instruction provides direction to the 222-S Laboratory for the performance of differential scanning calorimetry (DSC) and thermal gravimetric analysis (TGA) tests on archived material from single-shell tank 241-T-111. This letter also cancels the centrifugation and moisture measurements requested in the previous letter of instruction (Reference). The previously requested tests were determined not to be an effective means of addressing the U.S. Department of Energy, Headquarters' concerns regarding the safety of pumping the tank. Alternative testing to estimate the moisture that will remain in the waste after pumping is being considered and may be requested in the future. However, it has been determined that additional information on the waste energetics is necessary to evaluate the safety of pumping the tank.

Purpose: Perform additional DSC analysis and TGA on tank 241-T-111 archive sample to more accurately measure the exotherm observed in the sample.

Safety Considerations: Radioactive materials will be used in these tests, therefore all laboratory procedures applicable to radiological control will be adhered to in conjunction with as low as reasonable achievable (ALARA) practices dealing with hazardous materials in the preparation and handling of these samples.

Work Scope:

1. The sample to be analyzed in the archived sample from tank 241-T-111, core 33, segment 2 which had been dried, but never used, for adiabatic calorimetry analysis. Homogenize the sample to ensure that it is well mixed.

2. Obtain three aliquots from the sample and perform DSC and TGA analyses in duplicate on each aliquot. The sample size for the DSC analysis should be 5 to 10 milligrams. Perform the DSC under a nitrogen atmosphere.

3. Obtain two aliquots from the sample and perform DSC and TGA analyses in duplicate on each aliquot. The sample size for the DSC analysis should be twice the amount used in step 2 above (i.e., 10 to 20 milligrams). Perform the DSC under a nitrogen atmosphere.

Quality Assurance: If the sample and duplicate for a given aliquot do not agree within 25 calories/gram, rerun the DSC using a sample from the same aliquot. Approval designator Q has been established for this work; samples and the indicated number of duplicates shall be run. The DSC shall be performed in accordance with procedure number LA-514-113 and the TGA shall be performed in accordance with procedure number LA-560-112. The requirements of WHC-SD-CP-QAPP (Quality Assurance Project Plan for the Analysis of Highly Radioactive Mixed Waste Samples in Support of Environmental Activities on the Hanford Site) shall be implemented as applicable. The data shall be reviewed to ensure that all quality assurance/quality control requirements were met.

Data Evaluation: The 222-S Laboratory shall evaluate the results of the analyses against the DSC analyses performed previously on the tank T-111 samples that show exotherms in excess of 200 calories/gram (both cores 31 and 33) at both the 222-S and 325 laboratories. The evaluation should include a best estimate of the sample energetics along with uncertainties and the rationale behind the estimate.

Reporting Requirements: A letter presenting the results of the measurements will be the final deliverable of this task. The letter shall include a summary table of the results and a narrative. Advance notification of results via cc:mail is requested for representatives from the Characterization Program (D. R. Bratzel), Characterization Support (B. C. Simpson), Waste Tank Safety (H. Babad), Waste Tank Stabilization (D. B. Engelman), and TWRS Safety Analysis and Engineering (J. M. Grigsby). All analytical results shall be reported by May 3, 1994, the data evaluation shall be reported by May 5, 1994, and the letter report shall be issued by May 9, 1994.

Funding for this task is provided under task package control number N54D2. A cost estimate should be provided to the Characterization Program by May 3, 1994.

If there are any questions or comments regarding this letter, please contact L. M. Sasaki at 373-1027 or B. C. Simpson at 373-5915.

DRB

D. R. Bratzel, Manager
Analytical Integration
Characterization Program

mjg

Westinghouse Hanford Company

WHC-SD-WM-DP-058
REV. 0-A
Lows 5/24/94

Internal Memo

From: Analytical Integration 7E720-94-120
Phone: 373-3579 R2-18
Date: May 2, 1994
Subject: REVISED LETTER OF INSTRUCTION FOR TANK 241-T-111 ARCHIVE SAMPLES

To: J. G. Kristofzski T6-06

cc:

H. Babad	R2-78	K. L. Kocher	T6-06
G. S. Barney	T5-12	R. P. Marshall	T6-14
D. B. Bechtold	T6-09	L. M. Sasaki	R2-12
C. DeFigh-Price	R2-31	P. Segall	H4-19
D. B. Engelman	R1-49	B. C. Simpson	R2-12
J. M. Grigsby	H4-62	D. A. Turner	R2-78
C. S. Haller	R2-12	T. E. Whelan	S1-57
J. M. Kier	T3-01	LMS File/L8	

Reference: Internal Memo, D. R. Bratzel to J. G. Kristofzski, "Letter of Instruction for Tank 241-T-111 Archive Samples," dated April 29, 1994.

This letter of instruction (LOI) provides a revision to the referenced LOI. This revision expands the work scope to include additional differential scanning calorimetry (DSC) and thermal gravimetric analysis (TGA) tests on wet (as received) archive sample from tank 241-T-111, core 33, segment 2 and revises the due dates for the reporting of results. All other requirements of the referenced LOI remain the same.

Additional Work Scope:

1. The additional sample to be analyzed is the 20 gram of wet sample from the tank 241-T-111, core 33, segment 2 archived sample. This sample is being shipped from the Pacific Northwest Laboratory (PNL) 325 Building to the 222-S Laboratory for analysis. PNL is not able to analyze the sample at this time due to the stand down at the laboratory. Homogenize the sample to ensure that it is well mixed.

2. Obtain three aliquots from the sample and perform DSC and TGA analyses in duplicate on each aliquot. The sample size for the DSC analysis should be 5 to 10 milligrams. Perform the DSC under a nitrogen atmosphere.

3. Obtain two aliquots from the sample and perform DSC and TGA analyses in duplicate on each aliquot. The sample size for the DSC analysis on the wet sample should be five times the amount used in step 2 above (i.e., 25 to 50 milligrams). Perform the DSC under a nitrogen atmosphere.

Change to Reporting Due Dates:

Analytical results and preliminary data evaluation on the dried archived sample shall be reported by May 6, 1994. Final evaluation of both dry and wet sample results, in the form of a letter report, shall be made within four full working days after receip he sample from PNL.

WHC-SD-WM-DP-058
REV. 0-A

If there are any questions or comments regarding this letter, please contact L. M. Sasaki at 373-1027 or B. C. Simpson at 373-5915.

L. M. Sasaki
for D. R. Bratzel, Manager
Analytical Integration
Characterization Program

Westinghouse Hanford Company

WHC-SD-WM-DP-058
REV. 0-B

Internal Memo

From: Analytical Integration 7E720-94-122
Phone: 373-3579 R2-18
Date: May 12, 1994
Subject: LETTER OF INSTRUCTION FOR TANK 241-T-111 ARCHIVE SAMPLES - REVISION 2

To: J. G. Kristofzski T6-06

cc:

H. Babad	R2-78	K. L. Kocher	T6-06
G. S. Barney	T5-12	R. P. Marshall	T6-14
D. B. Bechtold	T6-09	L. M. Sasaki	R2-12
C. DeFigh-Price	R2-31	P. Segall	H4-19
D. B. Engelman	R1-49	B. C. Simpson	R2-12
J. M. Grigsby	H4-62	D. A. Turner	R2-78
C. S. Haller	R2-12	T. E. Whelan	S1-57
J. M. Kier	T3-01	LMS File/LB	

References: (1) Internal Memo, D. R. Bratzel to J. G. Kristofzski, "Revised Letter of Instruction for Tank 241-T-111 Archive Samples," dated May 2.1994.

(2) Internal Memo, D. R. Bratzel to J. G. Kristofzski, "Letter of Instruction for Tank 241-T-111 Archive Samples," dated April 29, 1994.

This letter of instruction (LOI) provides a second revision to the referenced LOIs. This revision eliminates the additional work scope requested in Reference 1. It has been determined that additional differential scanning calorimetry and thermal gravimetric analysis tests on wet (as received) archive sample from tank 241-T-111, core 33, segment 2 are not needed at this time. The final letter report should be issued by May 19, 1994.

If there are any questions or comments regarding this letter, please contact L. M. Sasaki at 373-1027 or B. C. Simpson at 373-5915.

DRB

D. R. Bratzel, Manager
Analytical Integration
Characterization Program

pkc

TO: JG Kristofzski, JM Frye, KL Kocher
FROM: TL Welsh, RD Cromar, R Jeppson
DATE: May 6, 1994
SUBJECT: Statistical Analysis of Core Segments

Performing a one-way analysis of variance (ANOVA) on segment two (core 33 only), we found that the standard deviation of segment two is 211.631 J/g dry wt. The ANOVA also leads us to conclude that some of the means are different. A multiple range comparison test showed that the means of the 1993 T-111 data and the present data are not statistically different, with a significance level of 0.05. These two means differ from the mean of the 1993 PNL data and also from the mean of the original data. The 1993 PNL mean and the mean of the original data also differ from each other.

Performing a one-way analysis of variance on segment one (core 33 only), the standard deviation of segment one is 169.621 J/g dry wt. The ANOVA leads us to conclude that the mean of the original data and the mean of the 1993 T-111 data are different. Using the error from segment two to test segment one, the means are also statistically different, with a significance level of 0.05.

Summary Statistics for Core Samples
(in J/g dry wt)

	Confidence Interval		Mean	Standard Deviation	RSD
	L.L.	U.L.			
Core 33, 1994	*	*	280.9	81.29	0.2894
Segment 1	441.50	3088.17	1764.83	532.67	0.3018
Segment 2	-164.55	2671.11	1253.28	1142.06	0.9113
Segment 3	-14518.56	17932.56	1707	1805.95	1.0580

Segment 1

Analysis of variance

Source of variation	Sum of Squares	d.f.	Mean square	F-ratio	Sig. level
Between groups	911070.25	1	911070.25	31.666	.0302
Within groups	57542.50	2	28771.25		
Total (corrected)	968612.75	3			

0 missing value(s) have been excluded.

adjusted $F = 20.34$

p-value $= .00071$

Segment 2

Analysis of variance

Source of variation level	Sum of Squares	d.f.	Mean square	F-ratio	Sig.
Between groups	11656441	3	3885480.2	86.753	.0000
Within groups	537452	12	44787.7		
Total (corrected)	12193893	15			

0 missing value(s) have been excluded.

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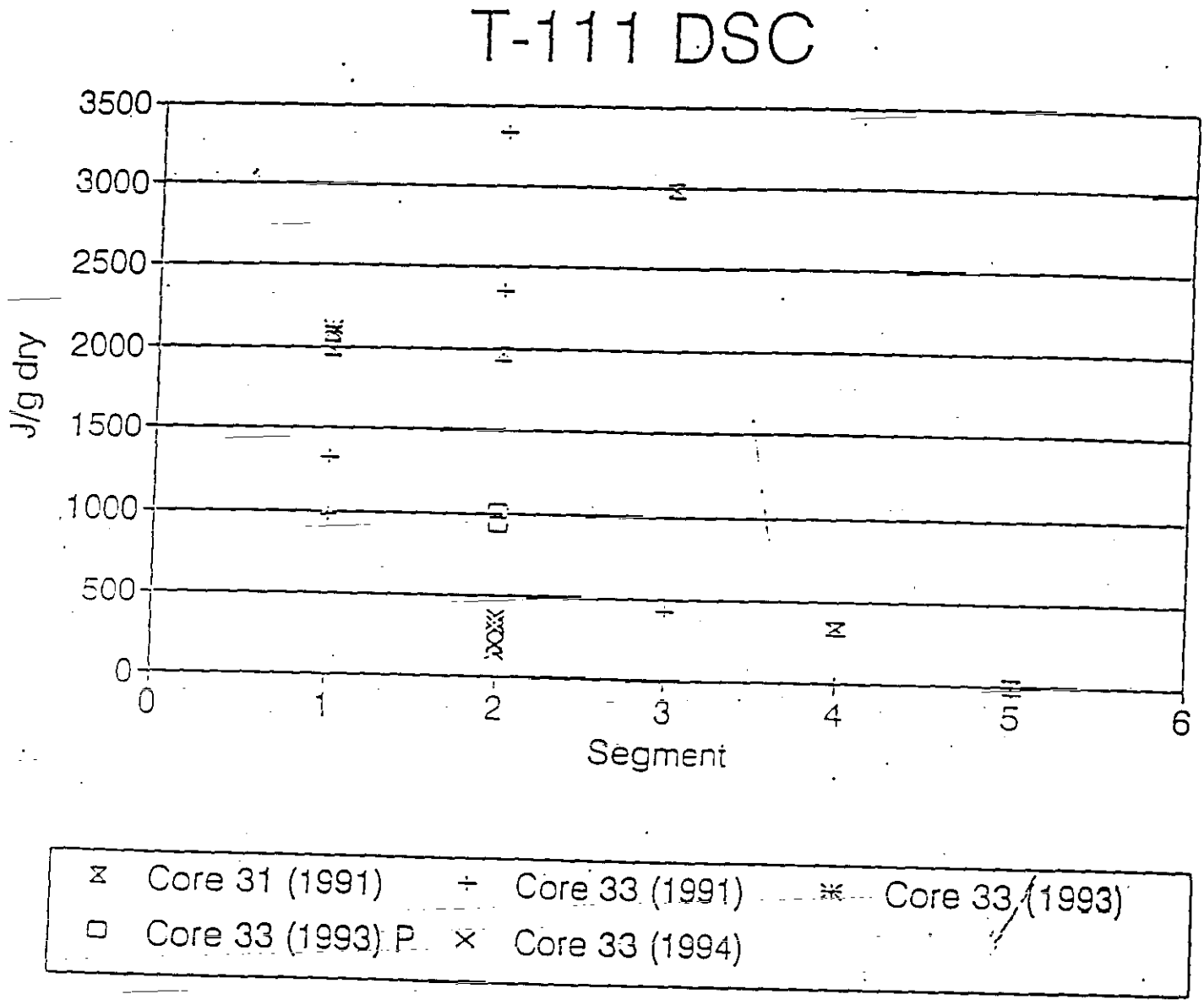

Preliminary Data for re-analysis on tank T-111 Core 33 Segment 2, May 2, 1994 All data is reported on a archive sample which was vacuum dried 60 degrees C. on 12/93. The analyses were performed under a nitrogen purge. This preliminary data fulfills the requirements per the letter or instruction (LOI) 7E720-94-119 and the revised LOI 7E720-94-120. The DSC values are not corrected and do not take into account the water content of the samples.

Laboratory Id. number	Sample #	Analysis	Sample Size (mg)	Result 1 J/g	Result 2 J/g
J1668-5711 J1668-5811	Sample 1 Sample 1 dup	DSC	16.957 13.267	251.2	269.0
J1669-5711 J1669-5811	Sample 2 Sample 2 dup	DSC	12.596 18.182	309.2	287.5
J1670-5711 J1670-5811	Sample 3 Sample 3 dup	DSC	5.897 6.179	180.2	187.1
J1671-5711 J1671-5811	Sample 4 Sample 4 dup	DSC	6.695 7.023	162.7	175.3
J1672-5711 J1672-5811	Sample 5 Sample 5 dup	DSC	7.740 6.154	336.3	335.9
Laboratory Id. number	Sample #	Analysis	Sample Size (mg)	Result 1 (% H2O)	Result 2 (% H2O)
J1668-5712 J1668-5812	Sample 1 Sample 1 dup	TGA	11.928 15.604	11.68	10.06
J1669-5712 J1669-5812	Sample 2 Sample 2 dup	TGA	17.548 19.760	10.66	9.90
J1670-5712 J1670-5812	Sample 3 Sample 3 dup	TGA	6.338 8.043	11.35	11.99
J1671-5712 J1671-5812	Sample 4 Sample 4 dup	TGA	7.786 5.750	12.07	12.08
J1672-5712 J1672-5812	Sample 5 Sample 5 dup	TGA	7.101 9.313	11.21	11.10

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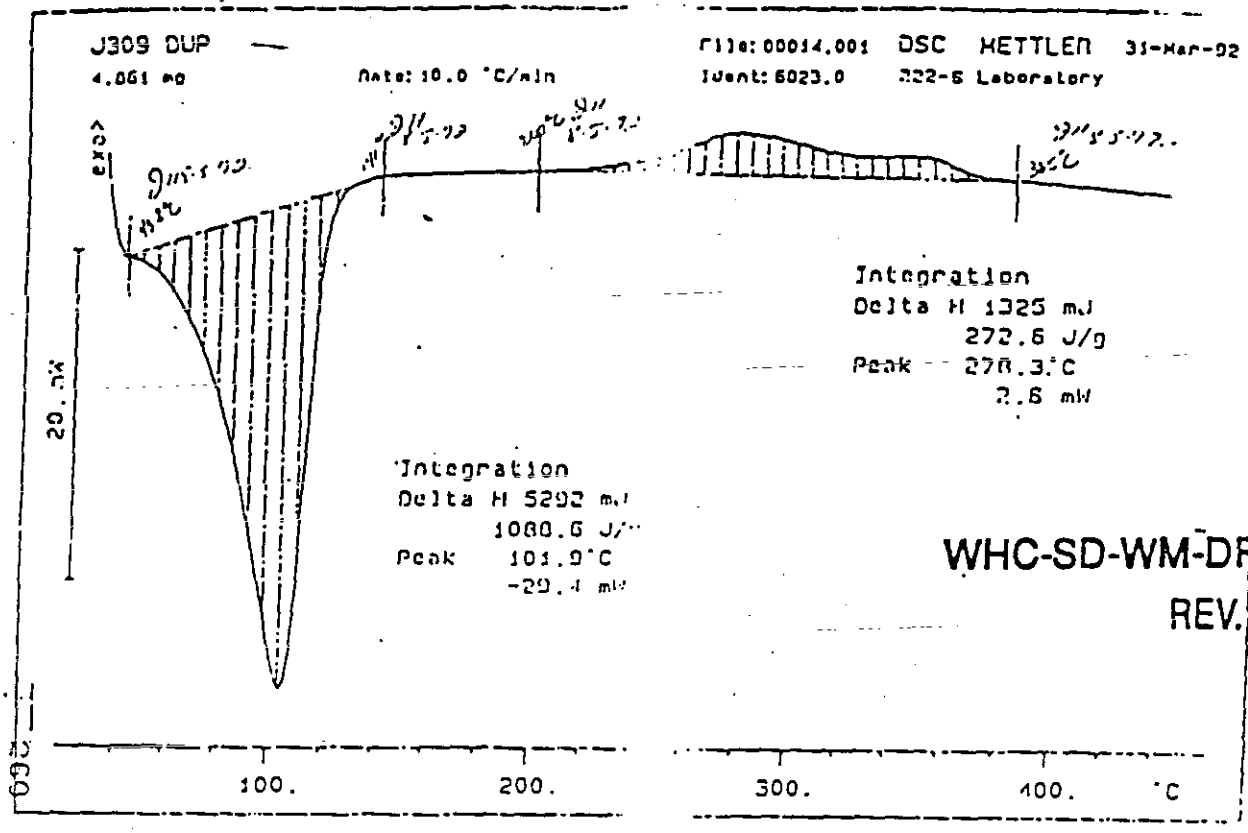
Original T-111 DSC Data 4/92

Core 31 seg 1, wet sample run under static air 4/92



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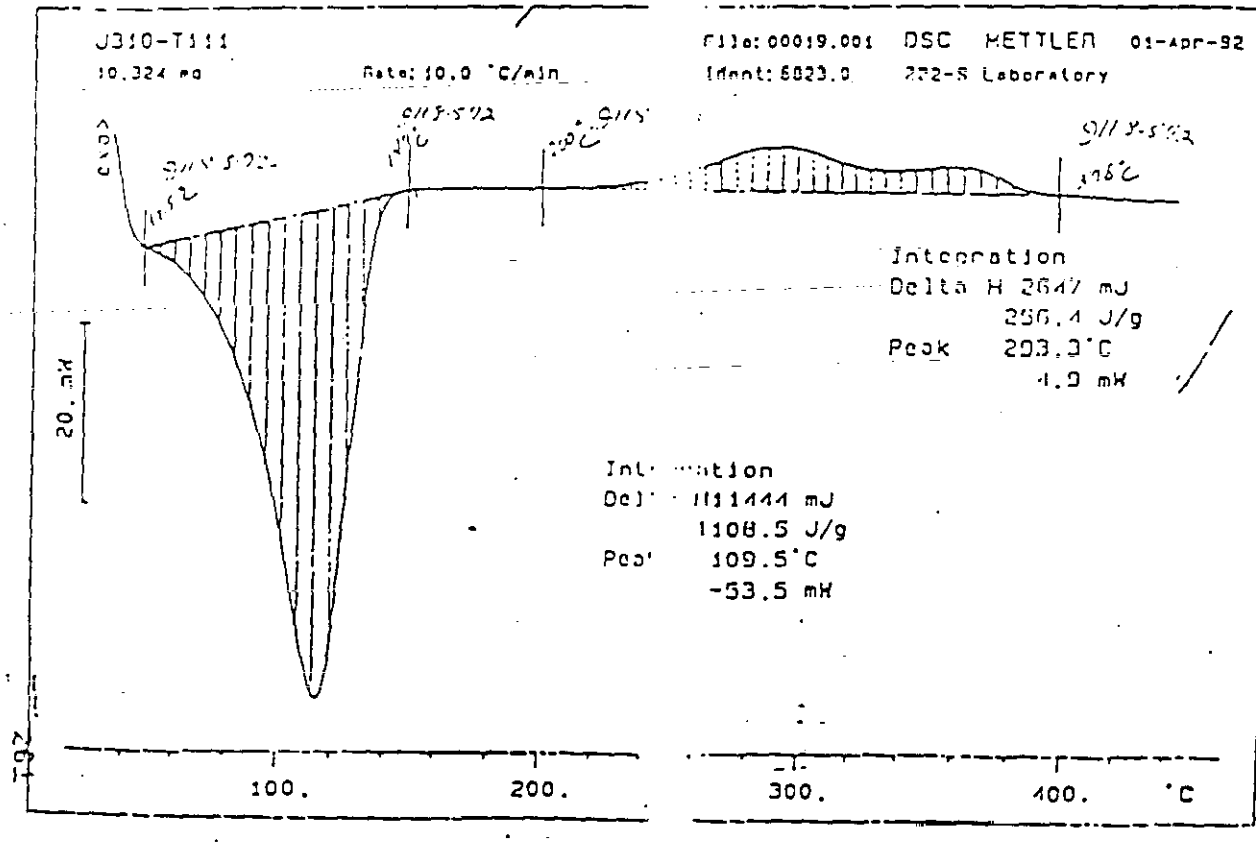
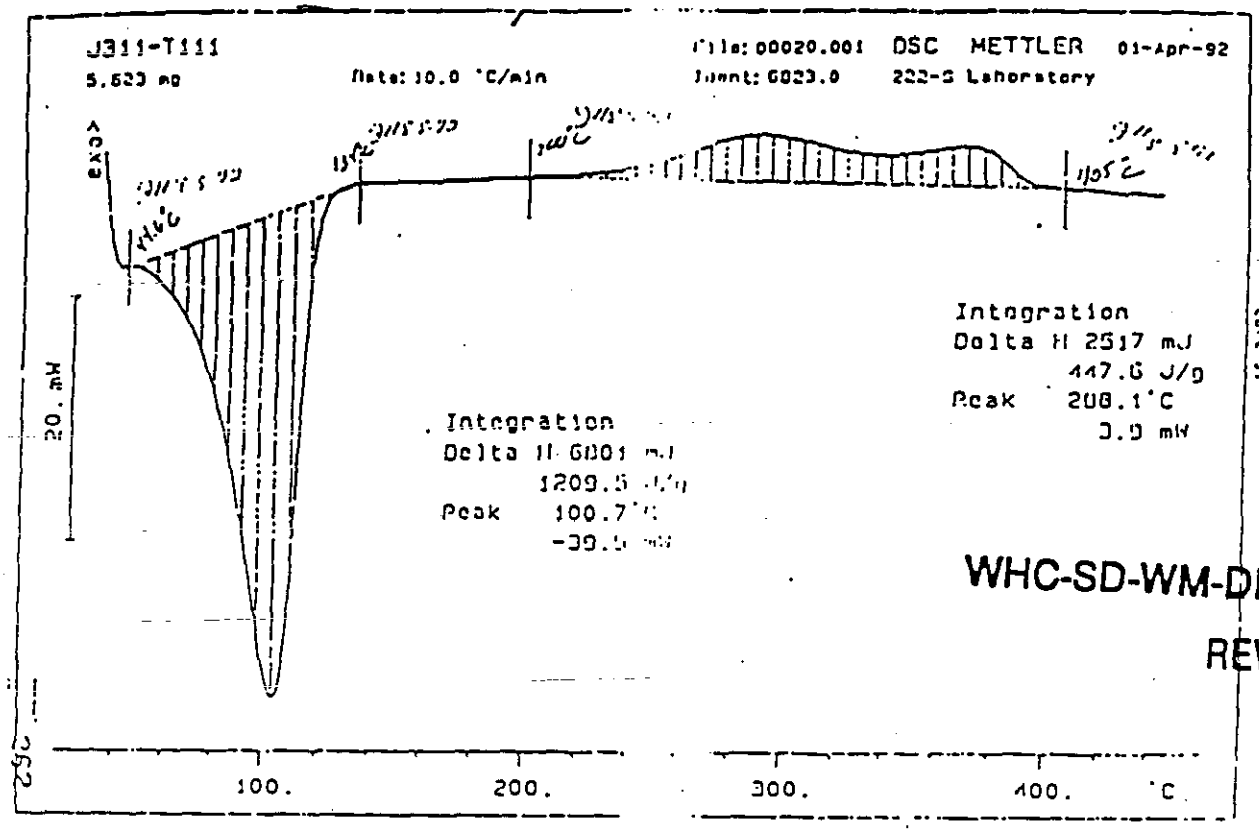
Core 31 seg 2, wet sample run under static air 4/92



Core 31 seg 3, wet sample run under static air 4/92



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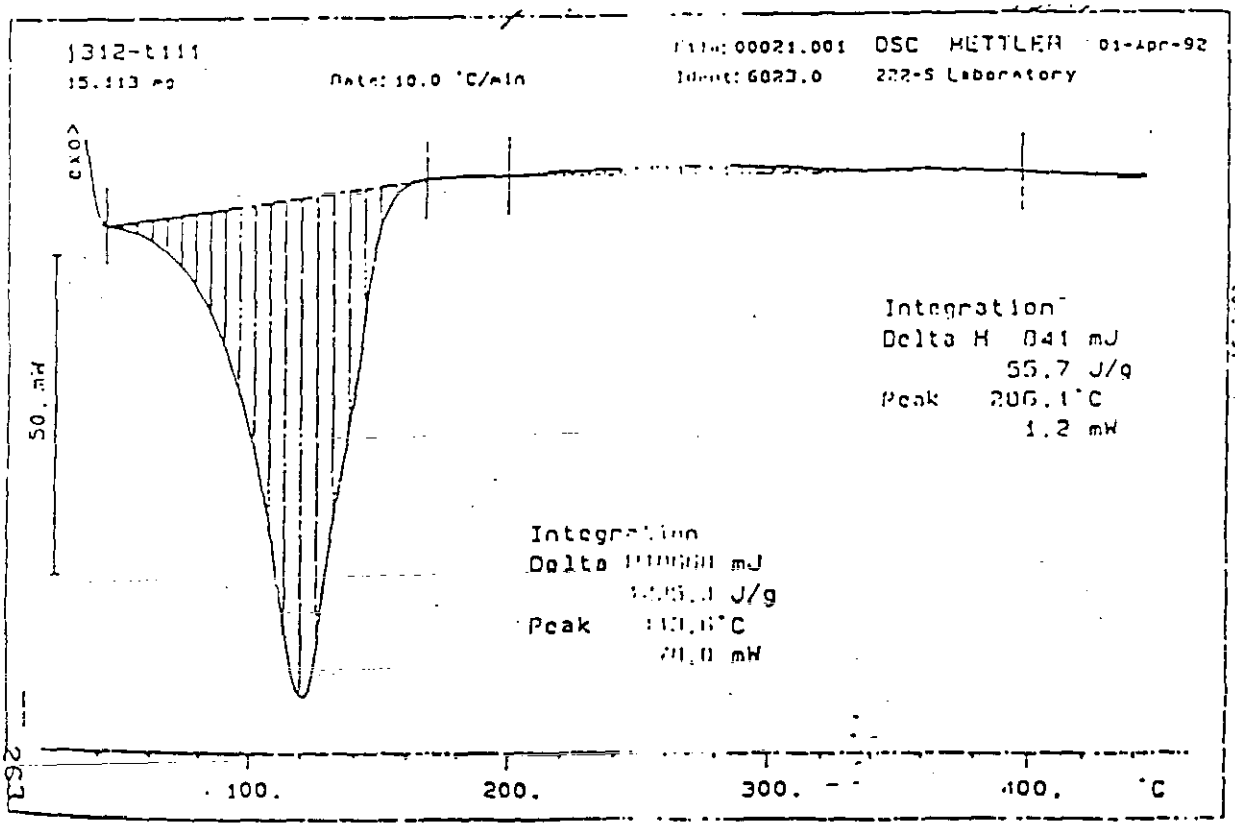
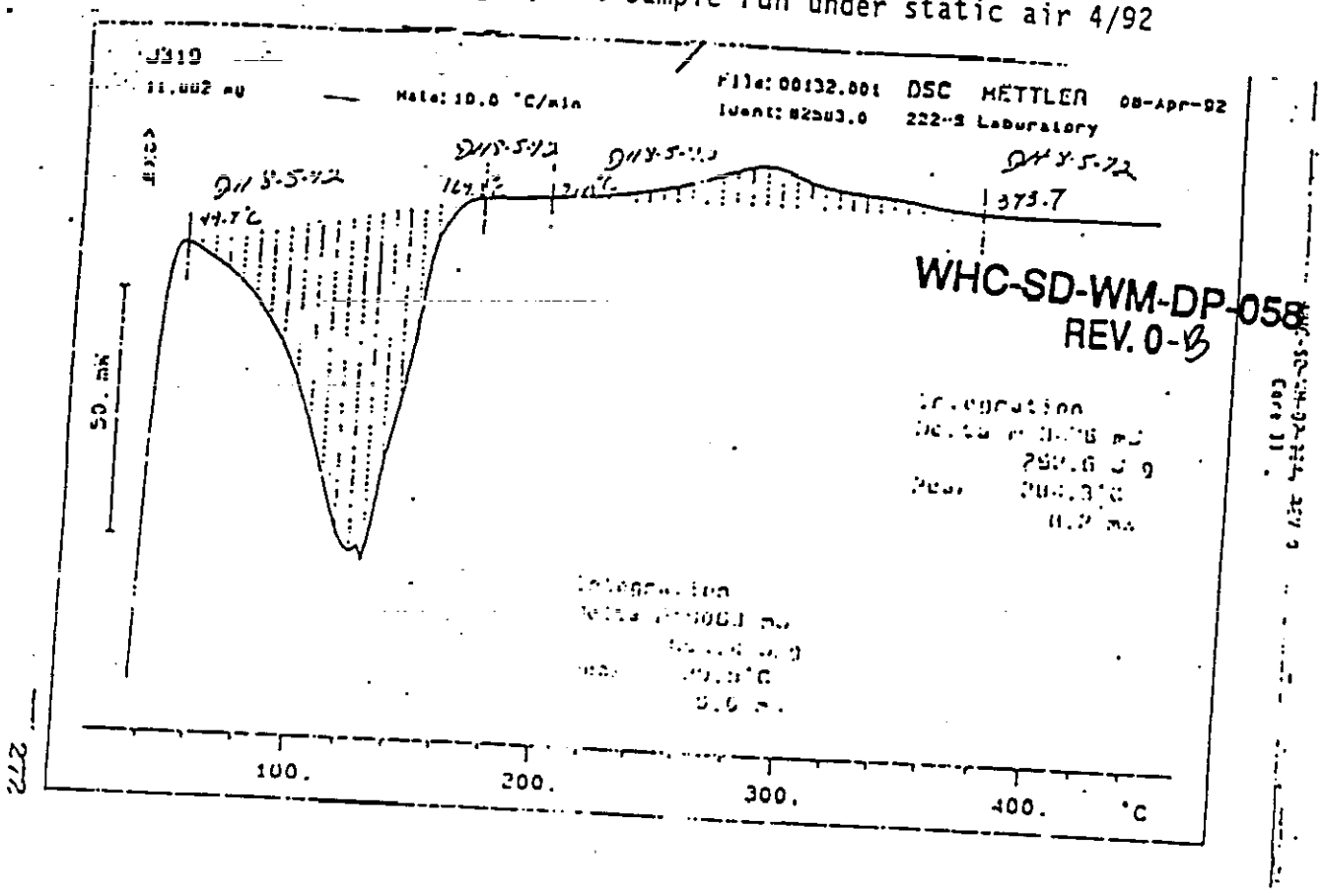
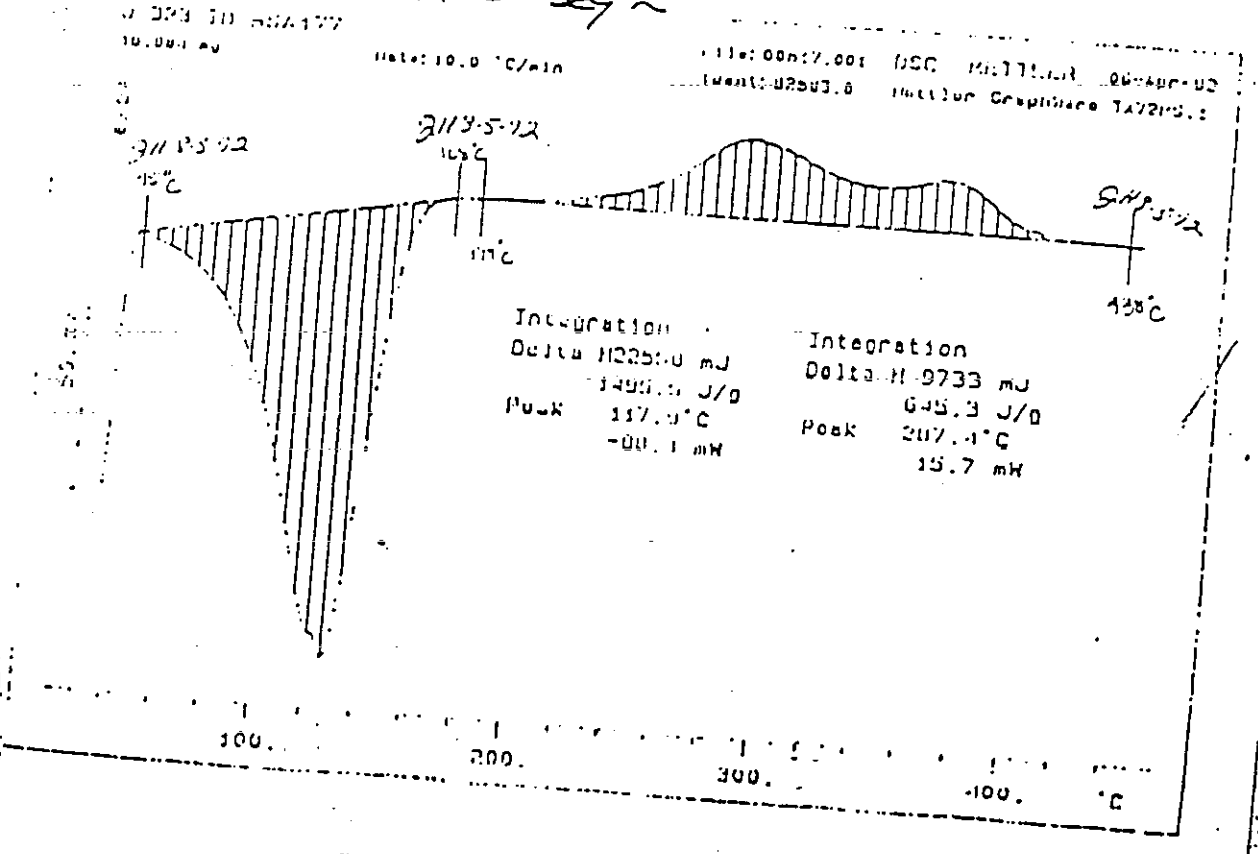
Core 31 seg 4, wet sample run under static air 4/92



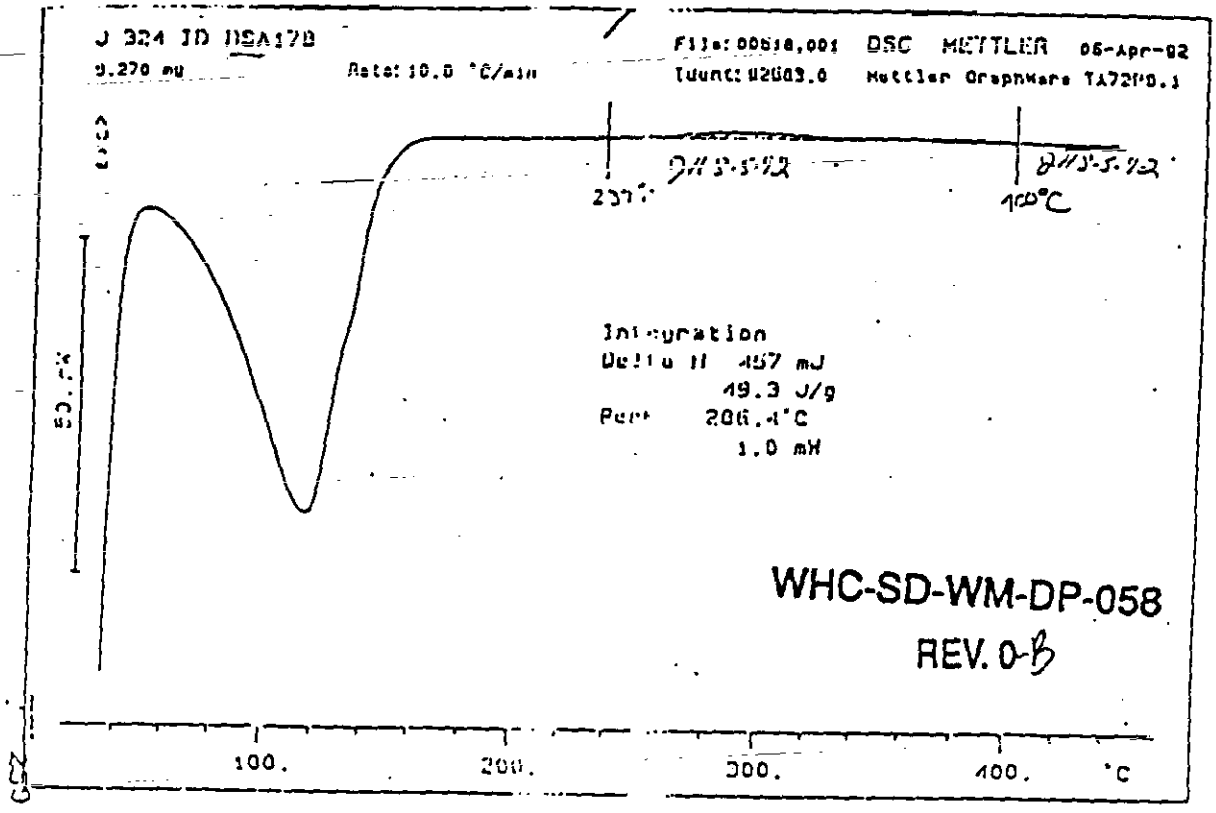
Core 33 seg 1, wet sample run under static air 4/92



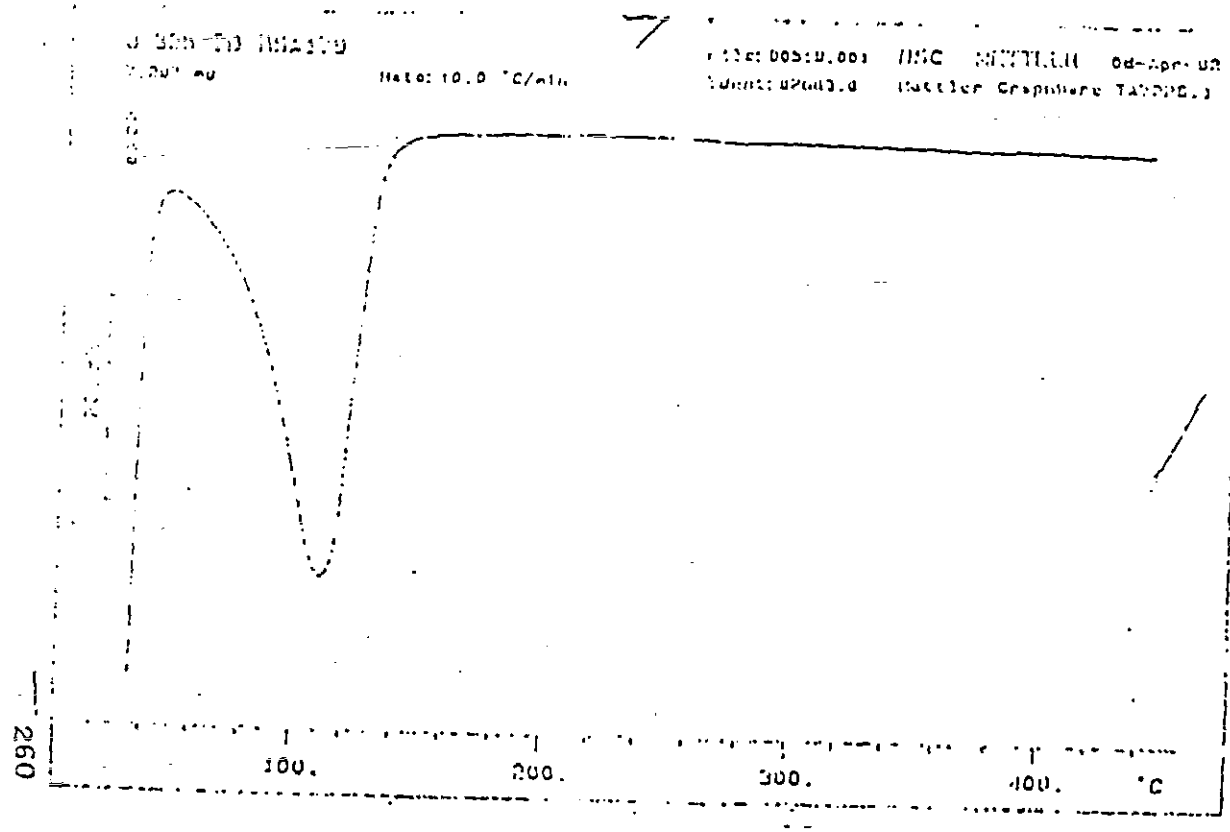
Core 33 seg 2, wet sample run under static air 4/92



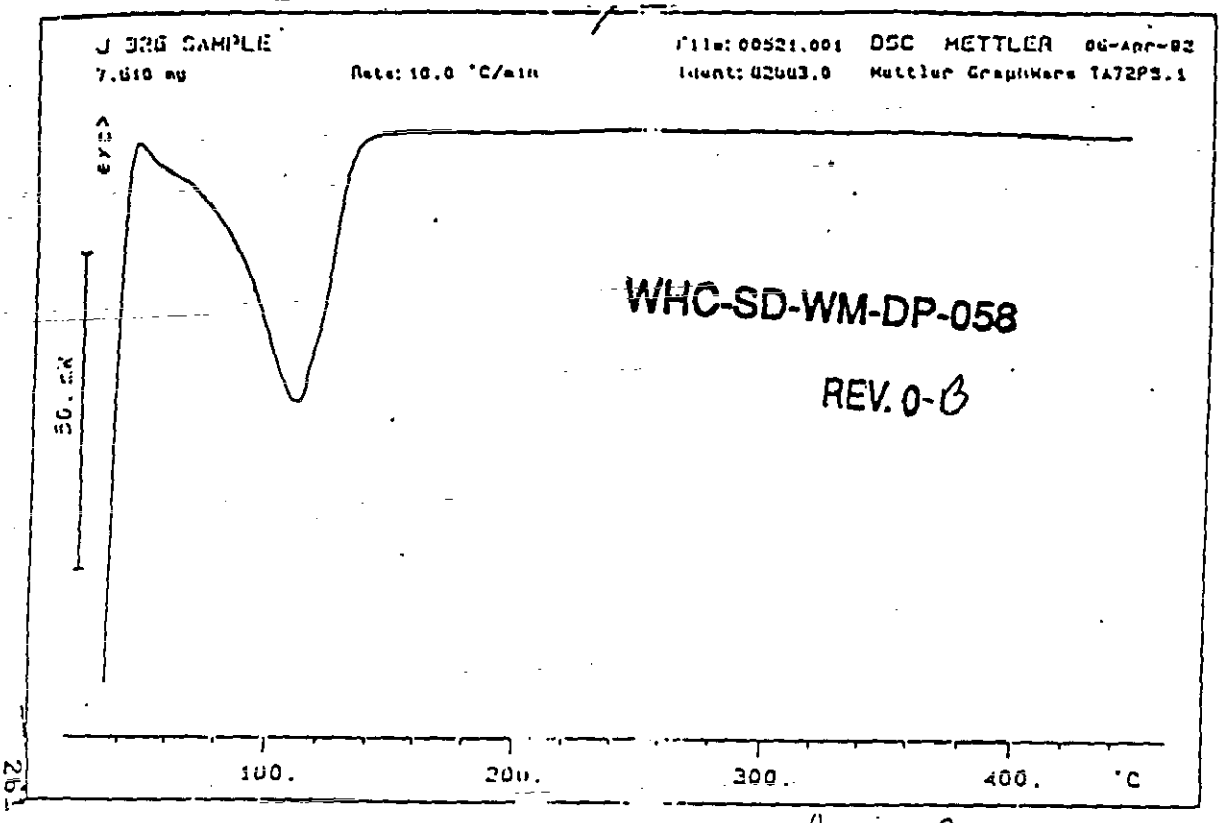
Core 33 seg 3, wet sample run under static air 4/92



Core 33 seg 4, wet sample run under static air 4/92



Core 33 seg 5, wet sample run under static air 4/92



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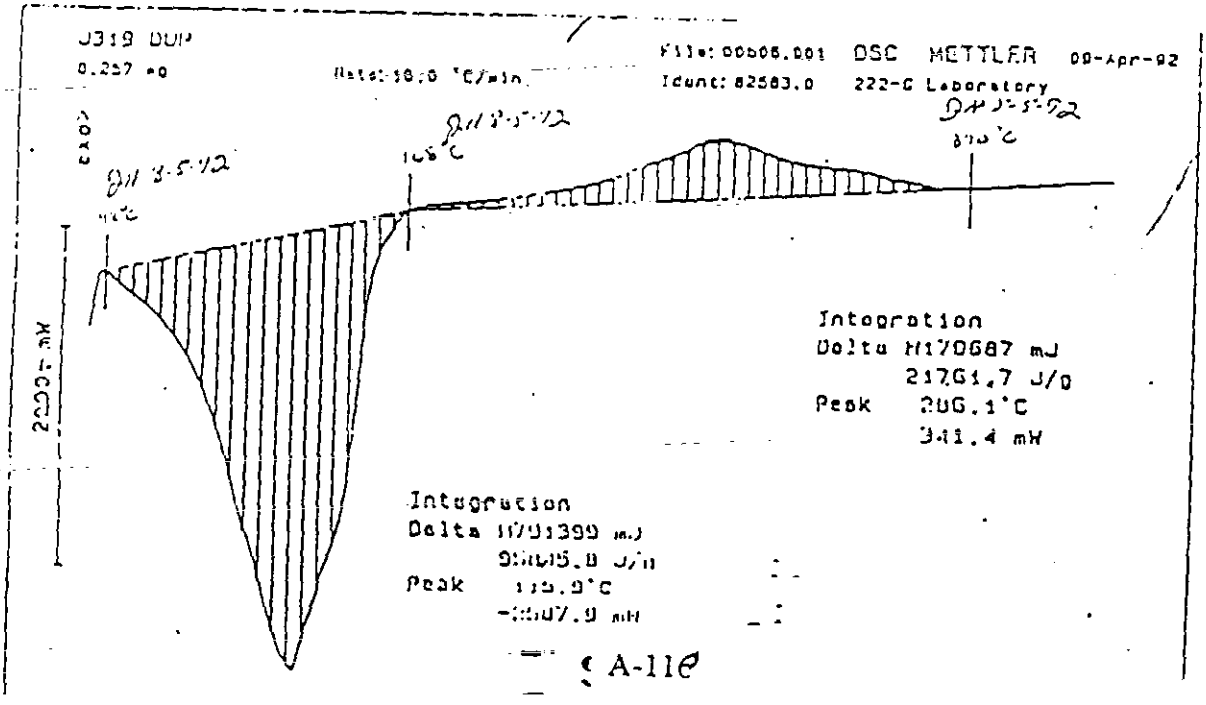
REV. 0-B

Core 33 seg 5, wet sample run under static air 4/92

Core 31 seg 1, wet sample run under static air 4/92



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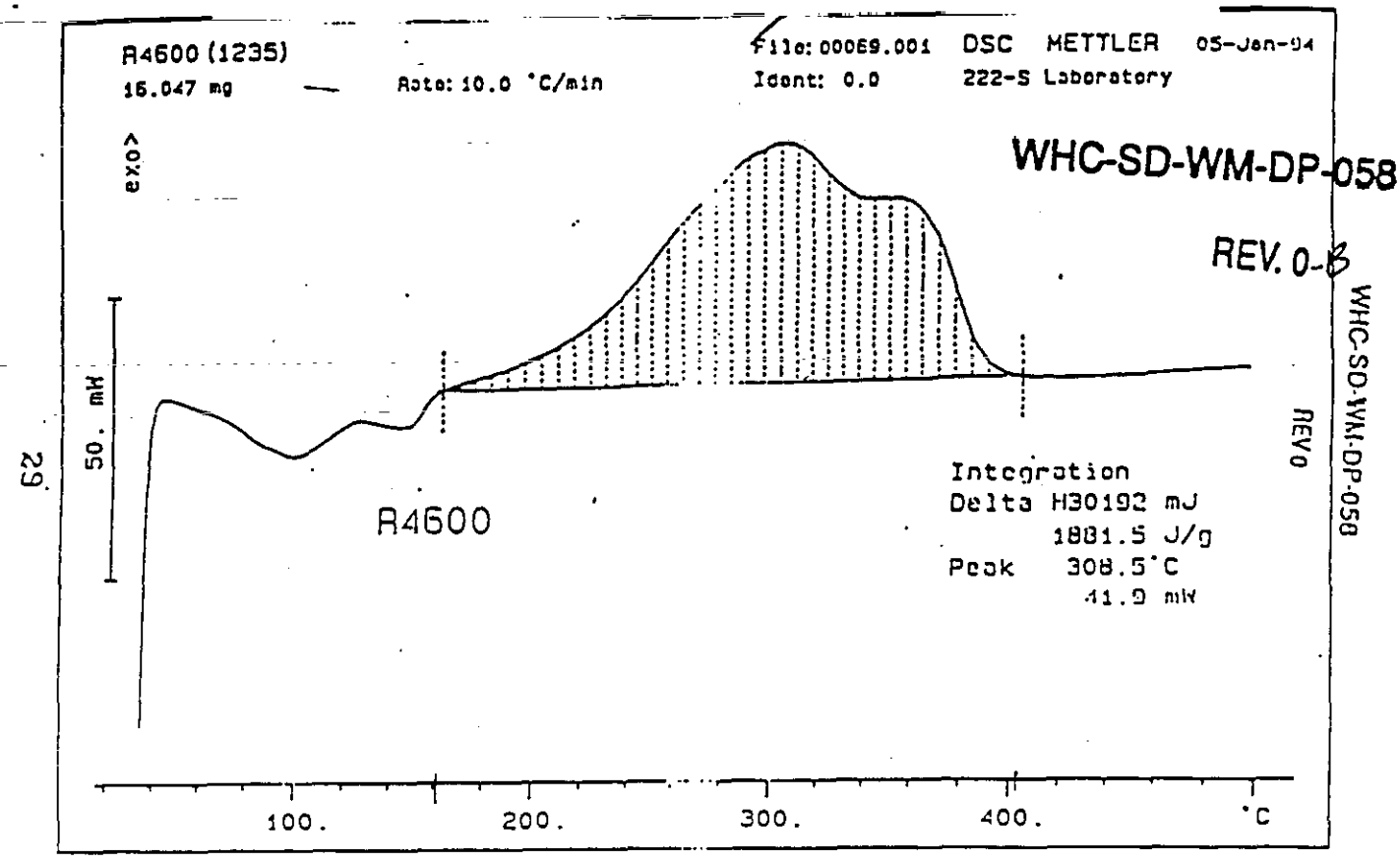
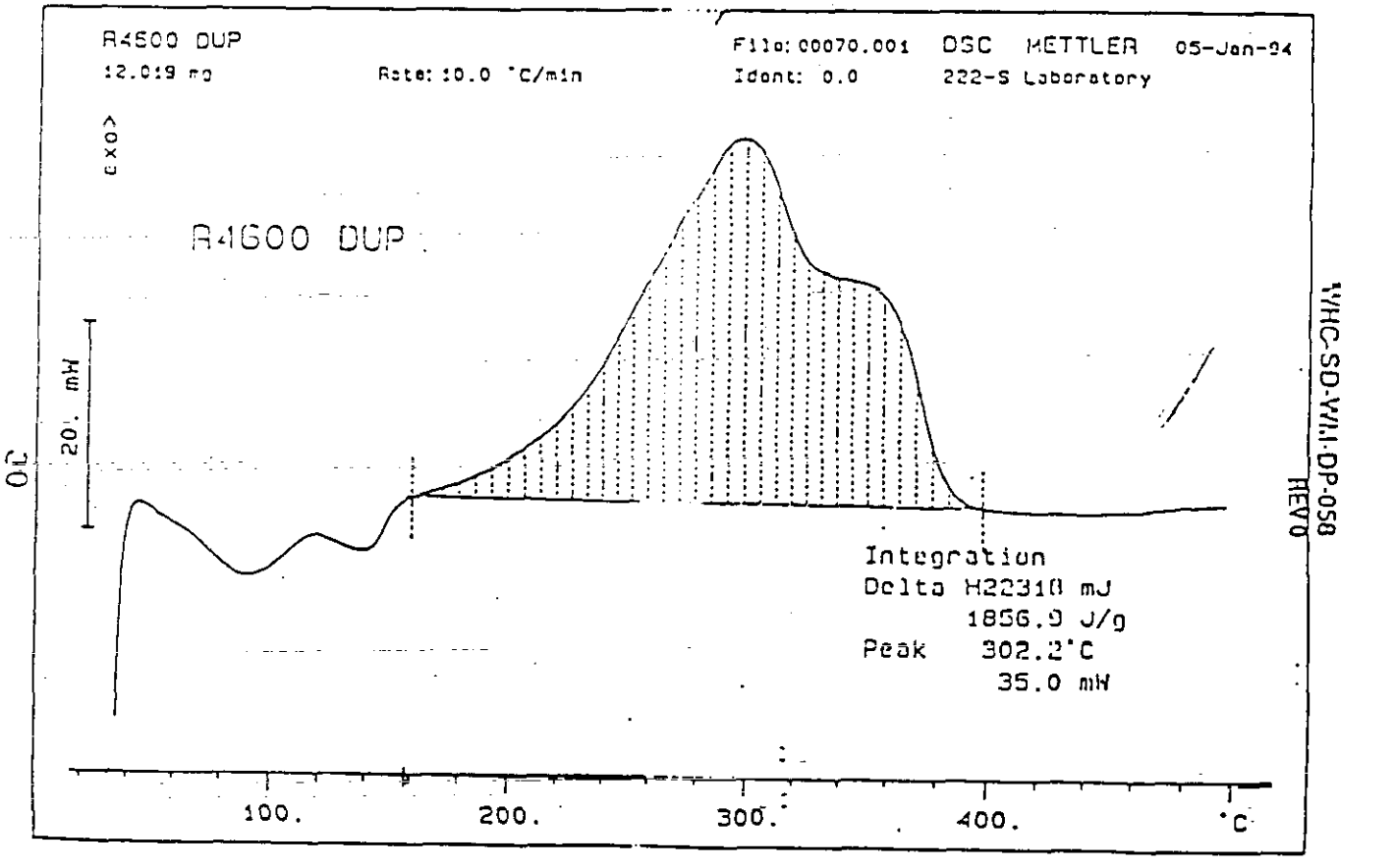
Re-analysis T-111 DSC Data 1/94

Core 33 seg 1, dried sample run under static air 1/94



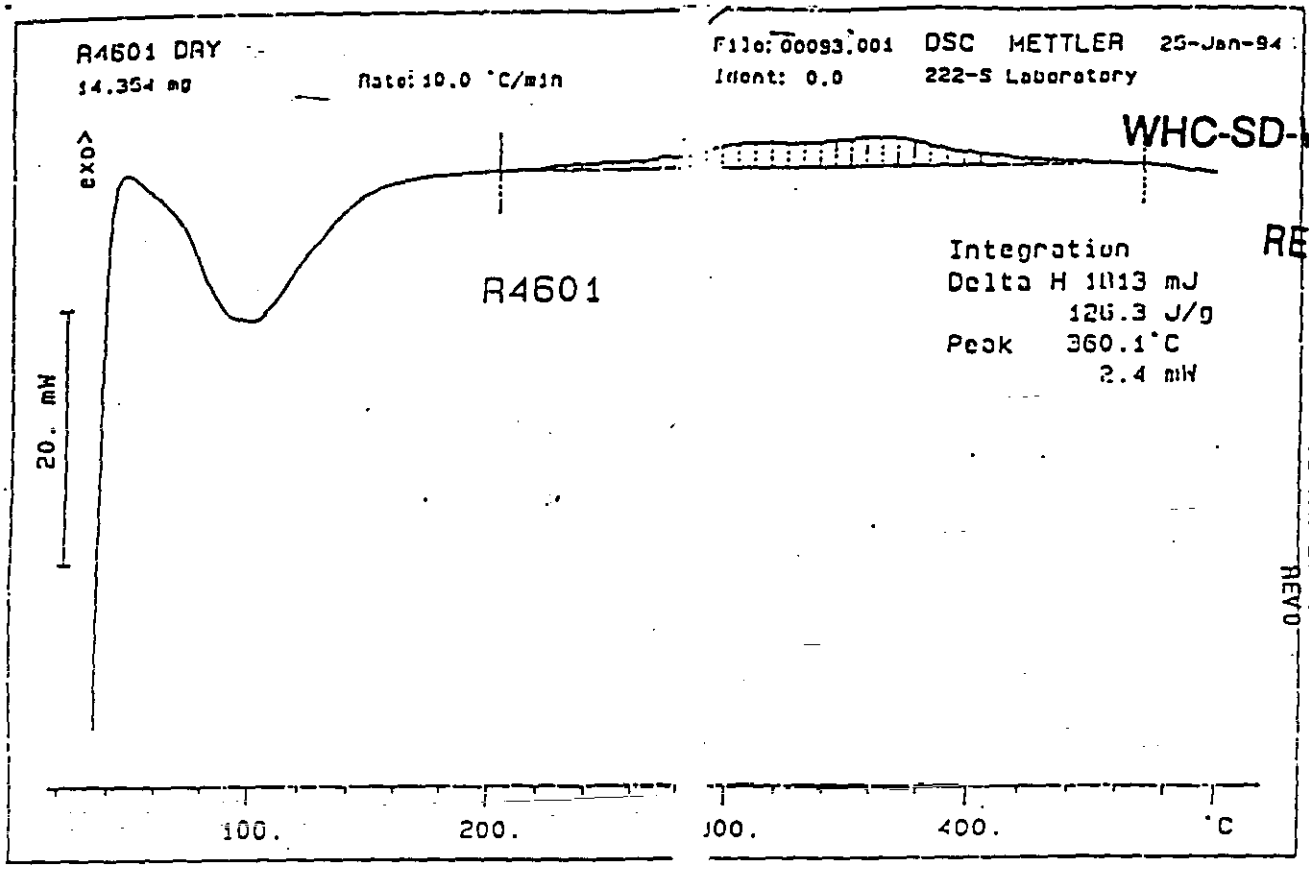
29

Core 33 seg 1, dried sample run under static air 1/94

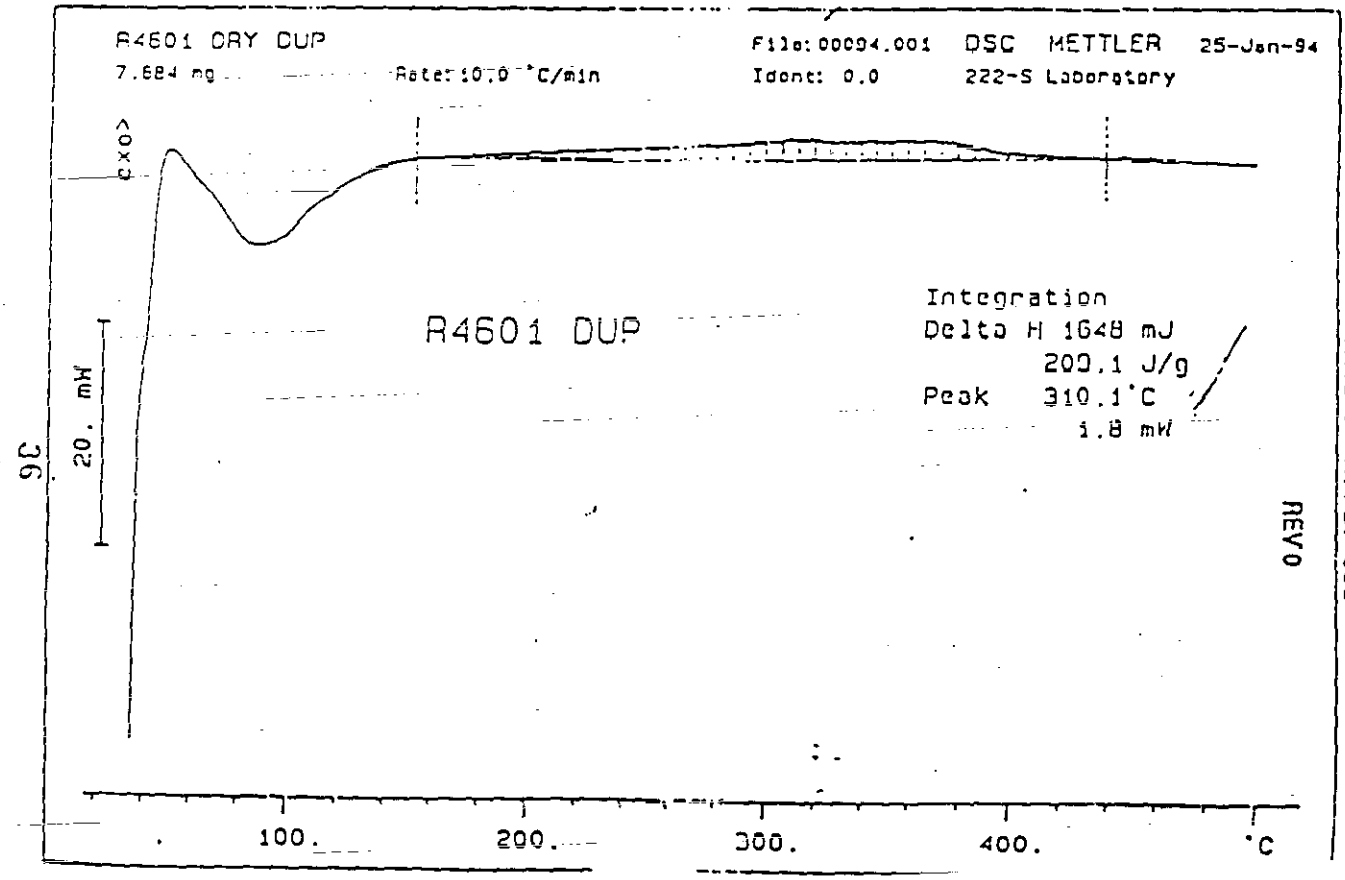


30

Core 33 seg 2, dried sample run under static air 1/94



Core 33 seg 2, dried sample run under static air 1/94

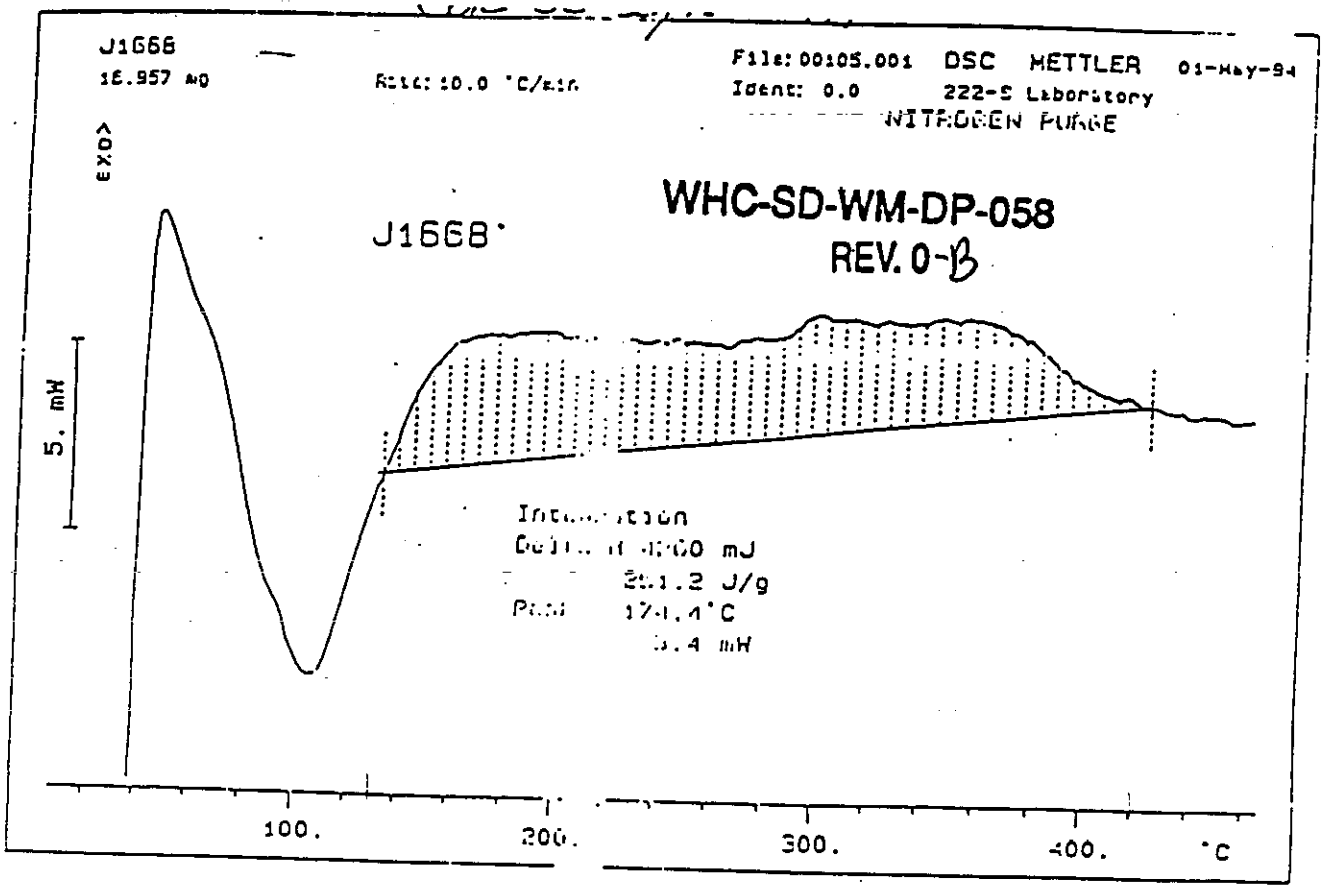


WHC-SD-WM-DP-058

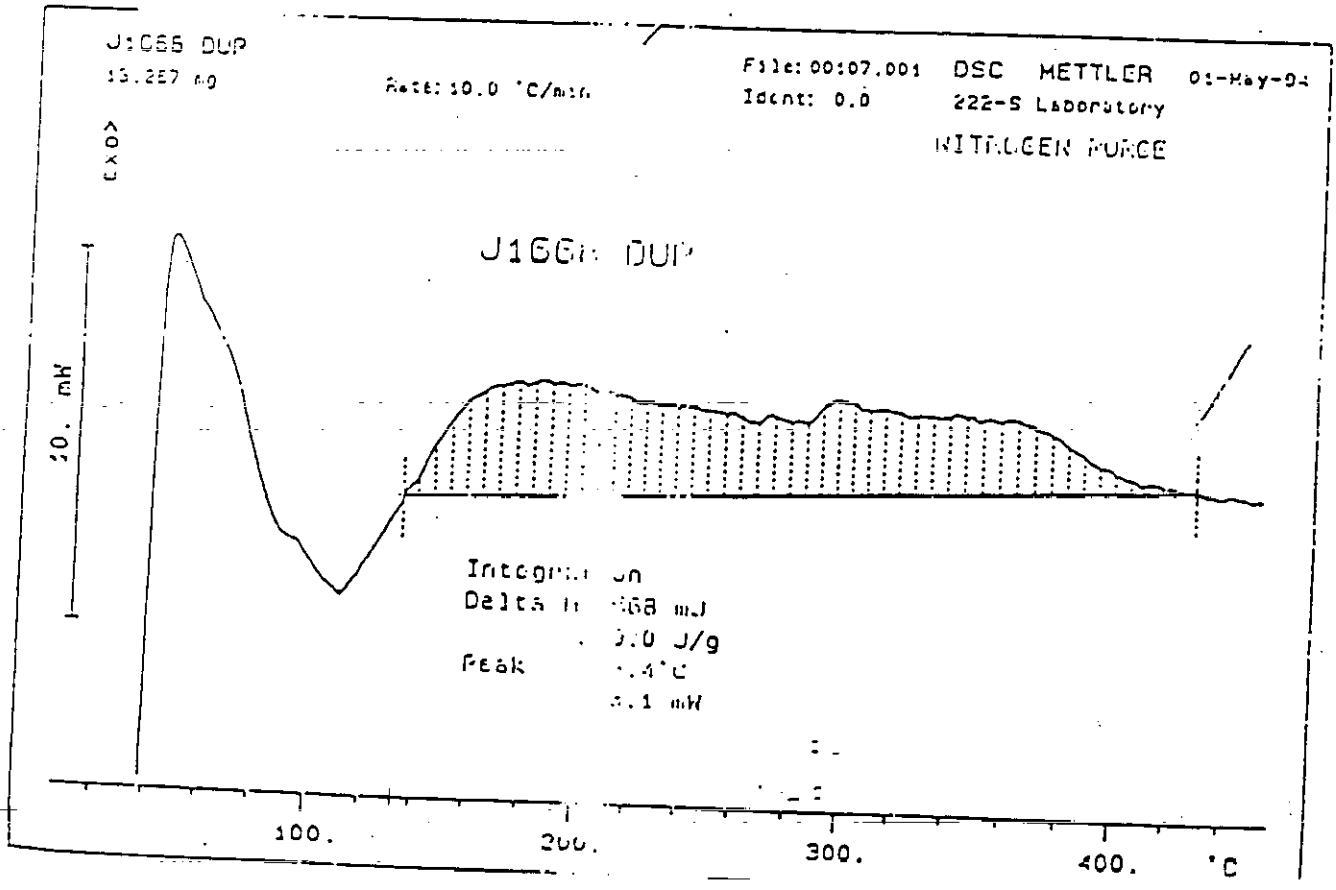
REV. 0-B

Re-analysis T-111 DSC Data 5/94

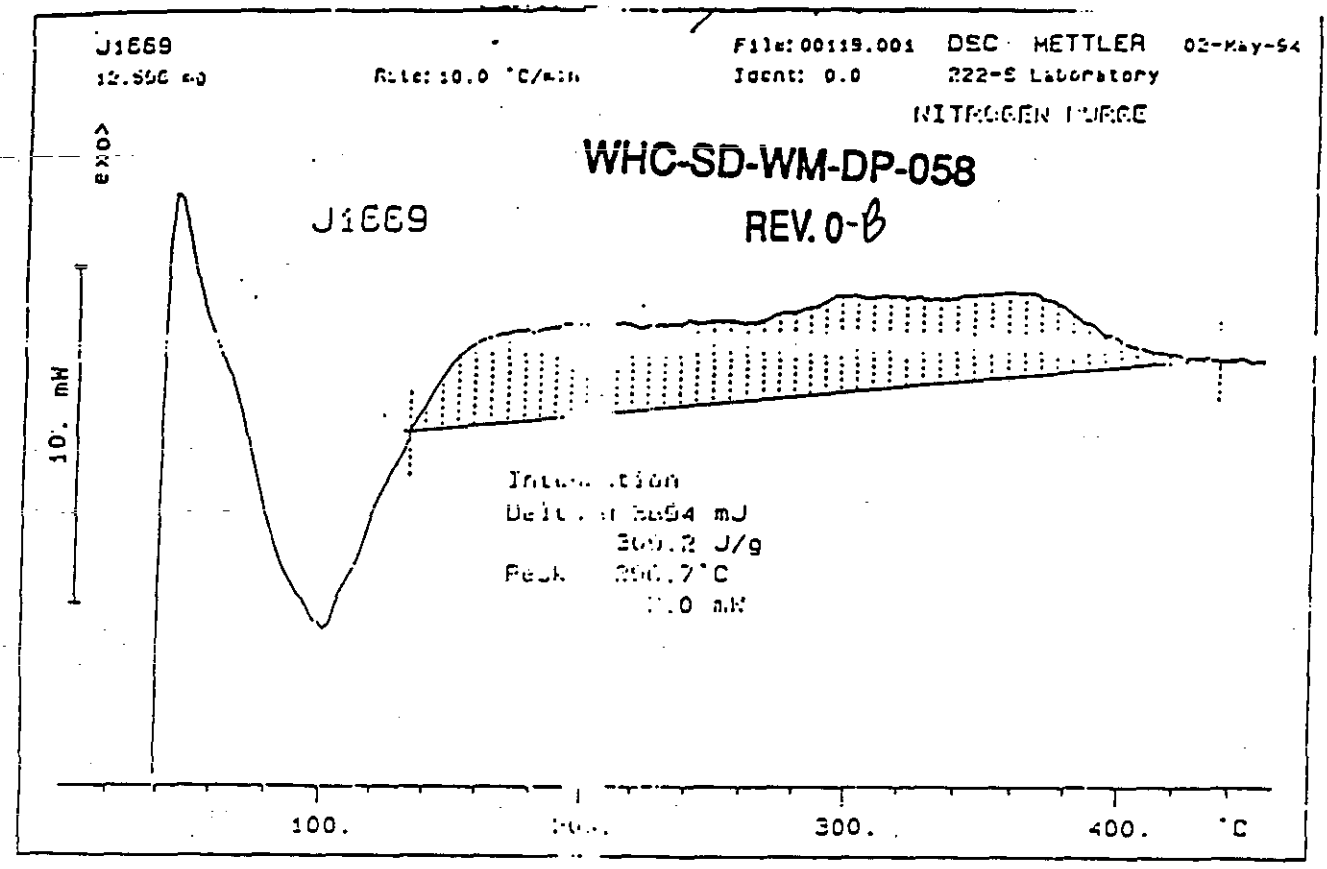
Core 33 seg 2, dried sample run under a nitrogen purge 5/94



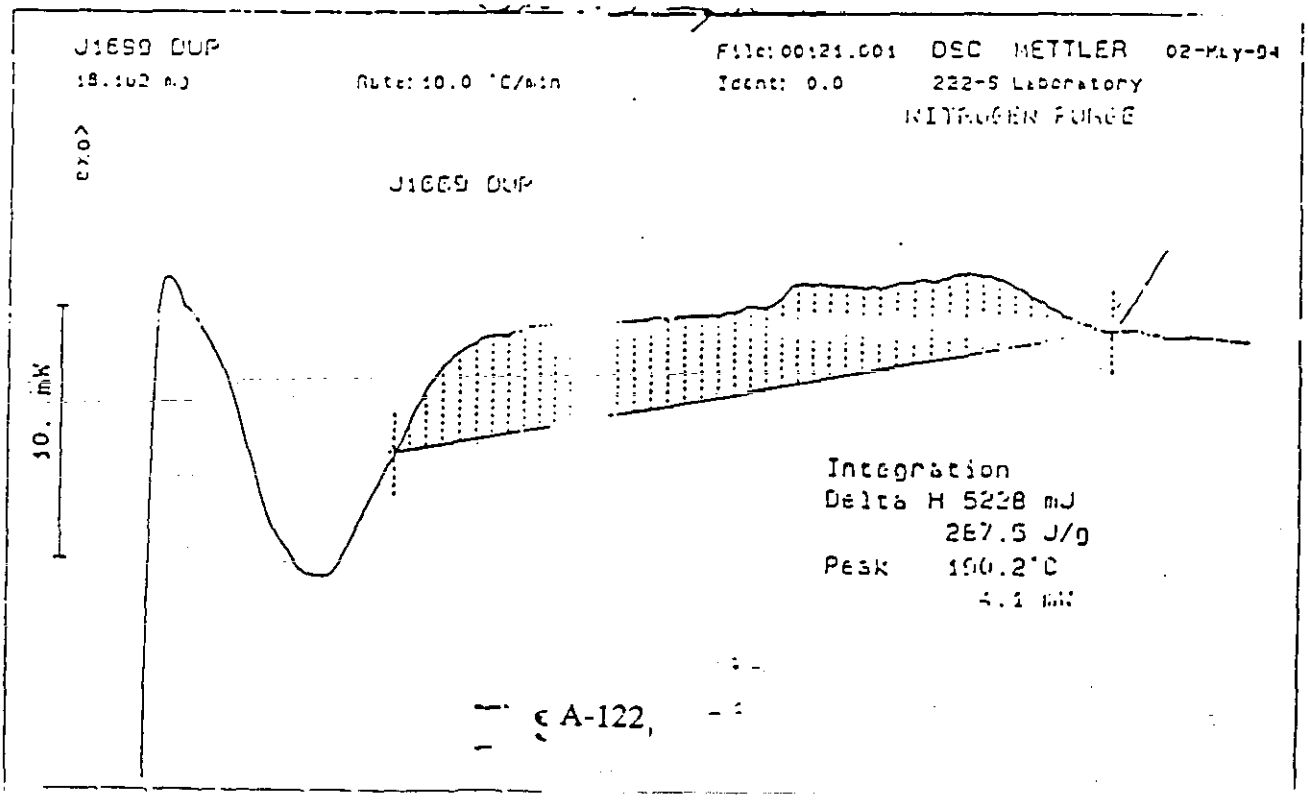
Core 33 seg 2, dried sample run under a nitrogen purge 5/94



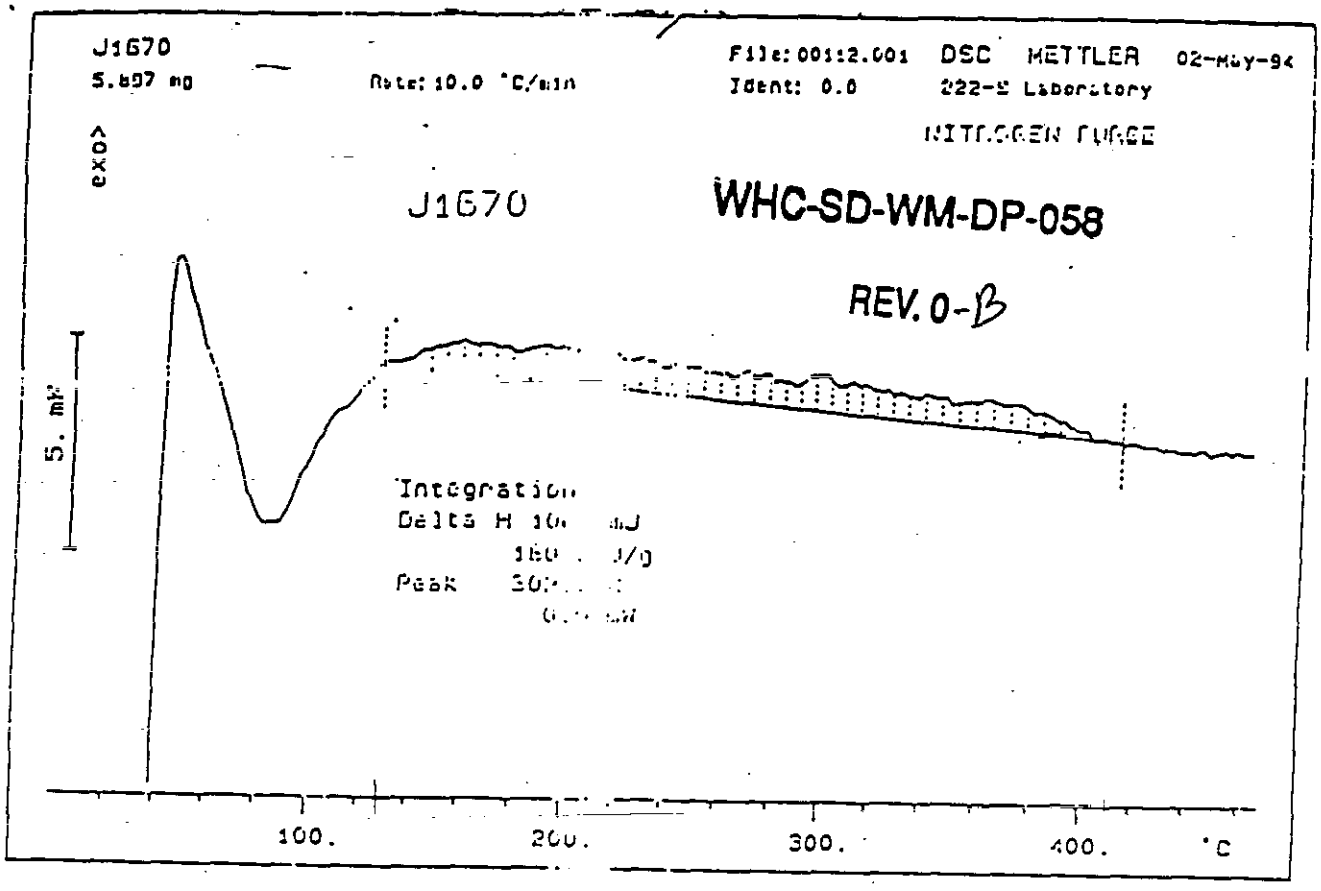
Core 33 seg 2, dried sample run under a nitrogen purge 5/94



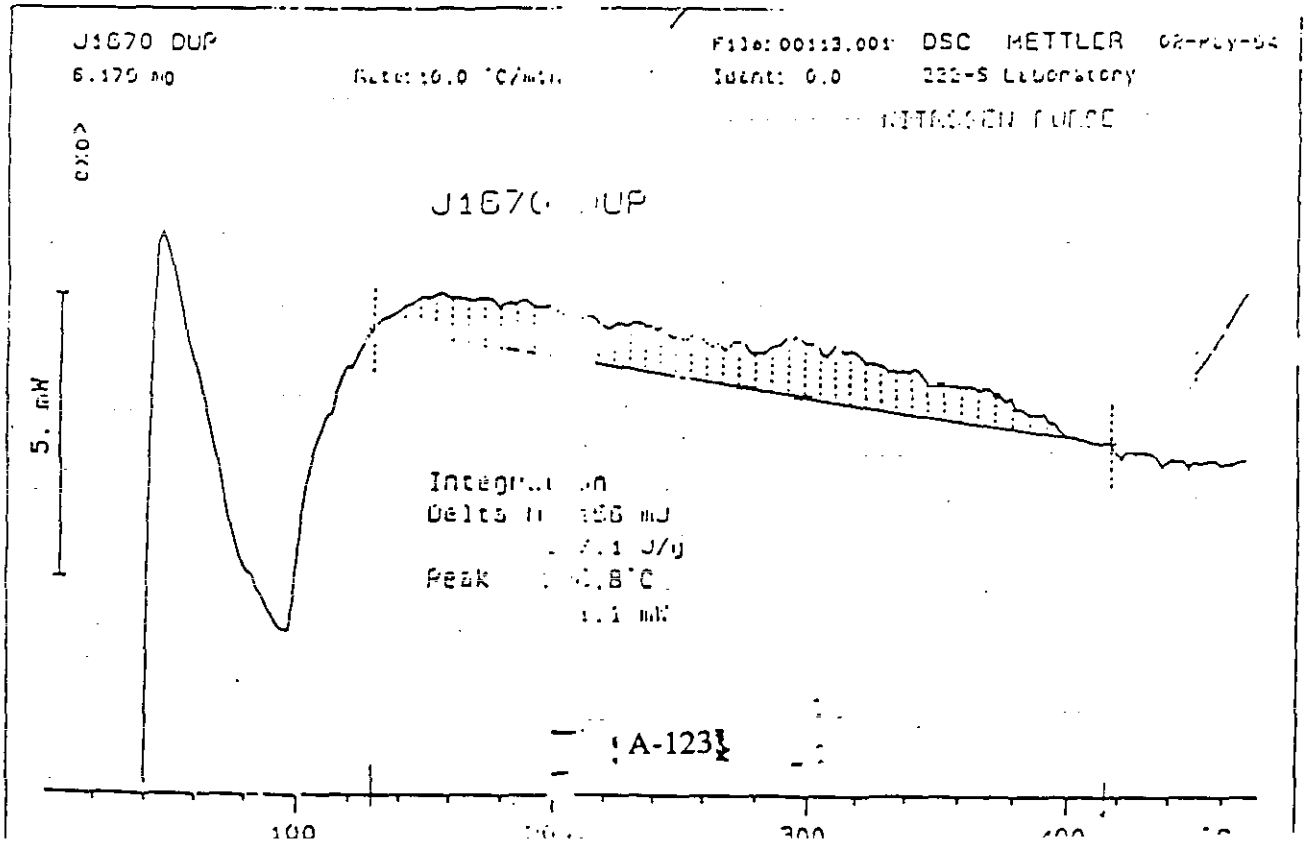
Core 33 seg 2, dried sample run under a nitrogen purge 5/94



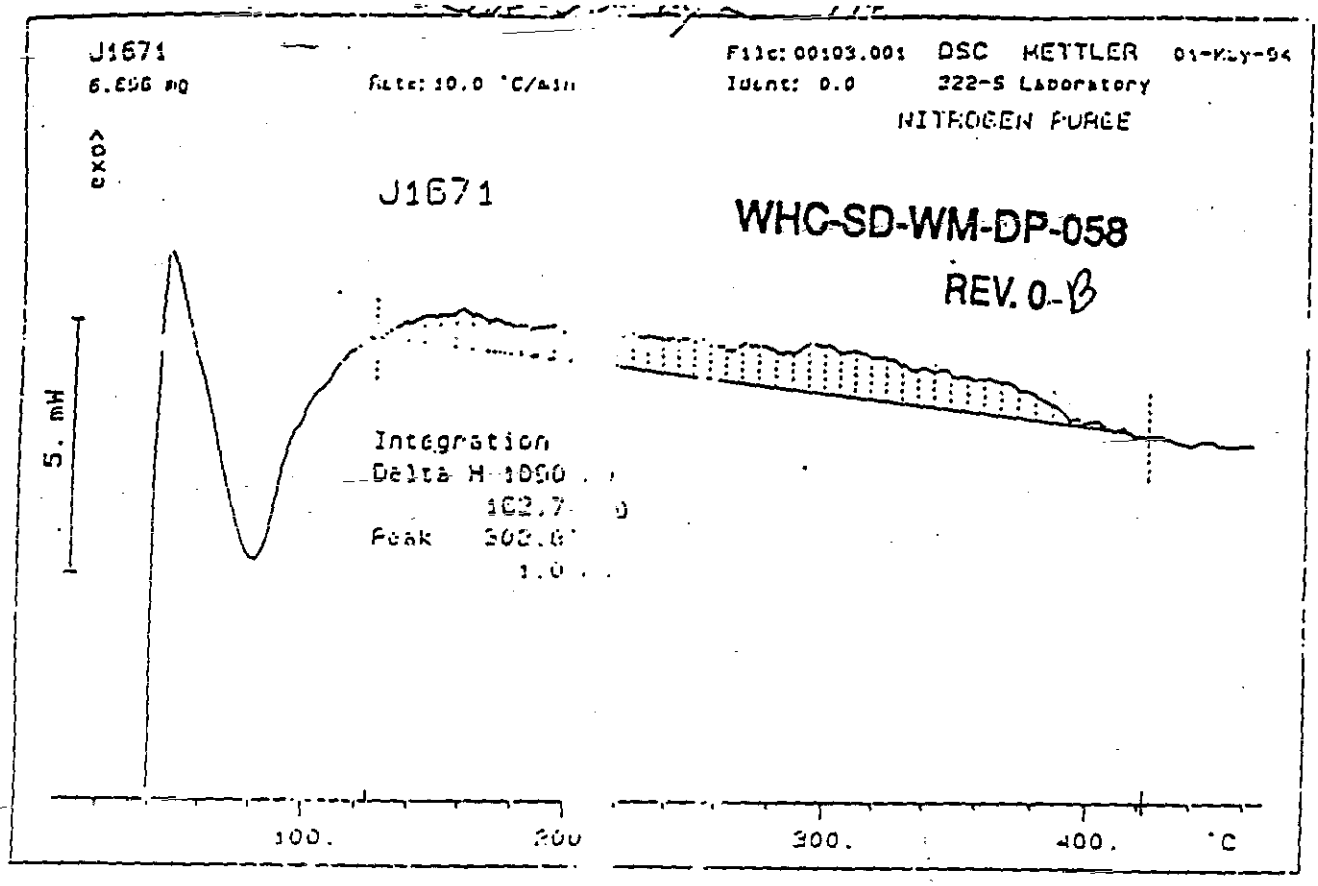
Core 33 seg 2, dried sample run under a nitrogen purge 5/94



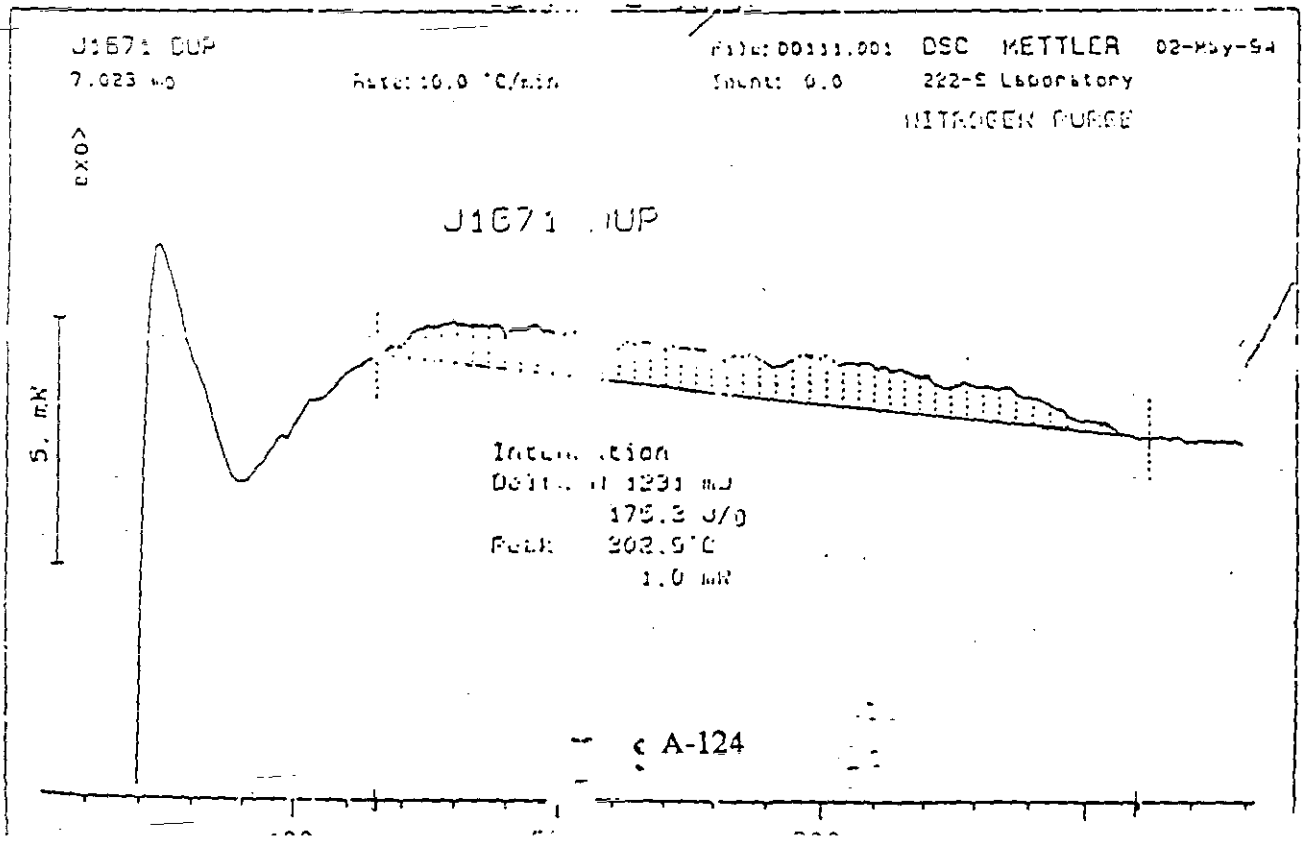
Core 33 seg 2, dried sample run under a nitrogen purge 5/94



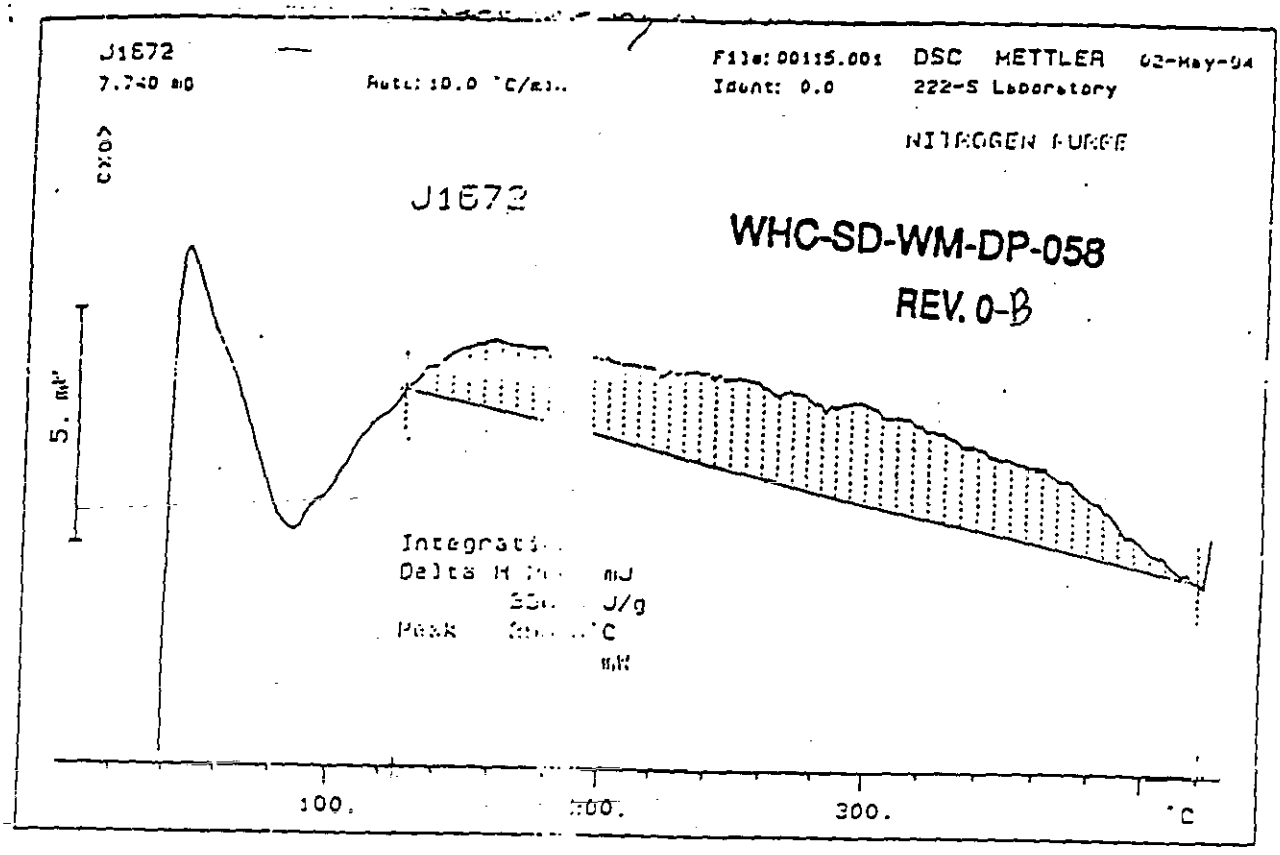
Core 33 seg 2, dried sample run under a nitrogen purge 5/94



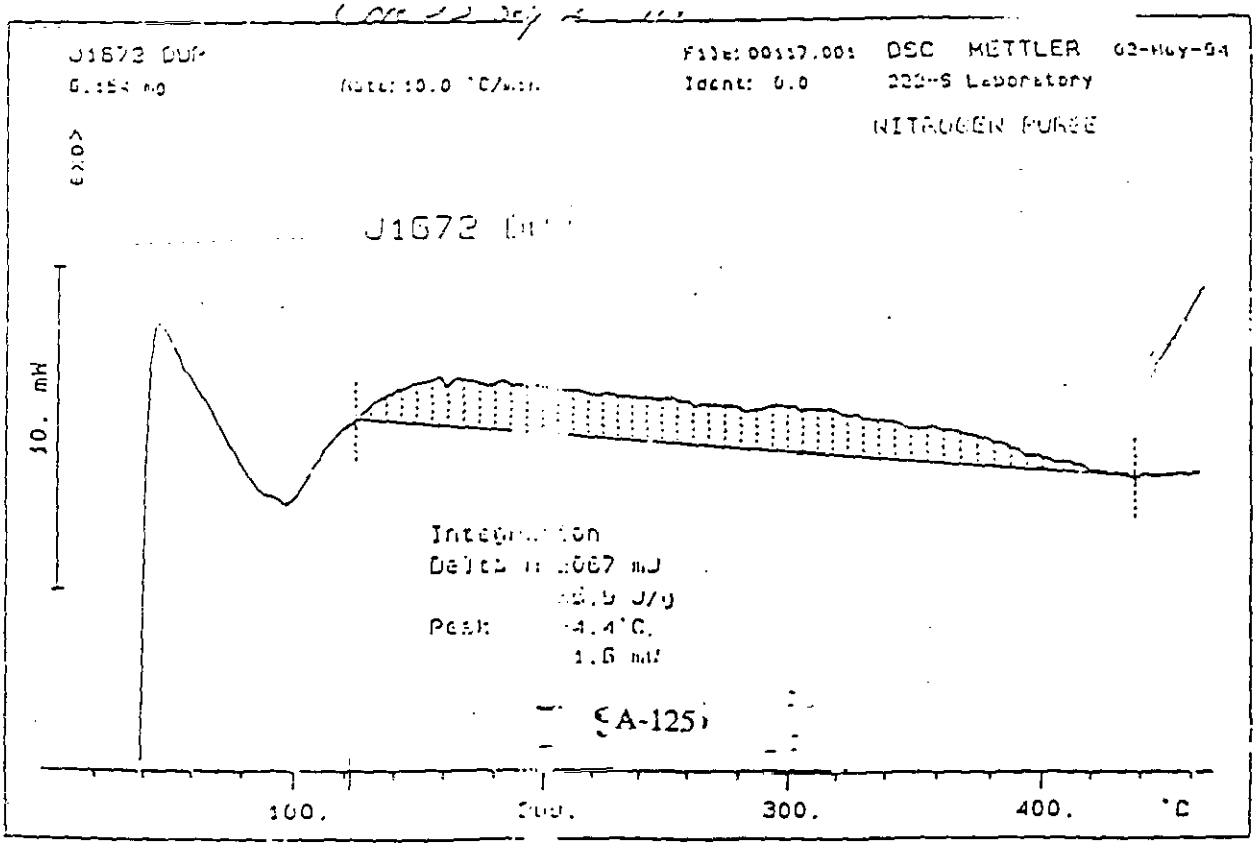
Core 33 seg 2, dried sample run under a nitrogen purge 5/94



Core 33 seg 2, dried sample run under a nitrogen purge 5/94



Core 33 seg 2, dried sample run under a nitrogen purge 5/94



SA-125

WHC-SD-WM-DP-058

REV. 0-B

PNL Re-Analysis 12/93

WHC-SD-WM-DP-058
REV. 0-B

Thermal Analysis Data

Thermal analyses of tank waste material from Tank 241-T-111 Core 33, Segment 2 were performed in duplicate. The thermal analysis includes both differential scanning calorimetry (DSC) and scanning thermogravimetry (TGA). DSC analyses were performed on dried sample material, but the TGA analyses were performed on the as-received sample. These analyses were performed according to technical procedure PNL-ALO-508, "Laboratory Procedure for Operation of the Differential Scanning Calorimeter (DSC), Thermogravimetric Analyzer (TG), and High Temperature Differential Thermal Analyzer (DTA) and DSC."

DSC analyses of sample 92-05856-N and it's duplicate were performed on a Perkin Elmer Model 2 Differential Scanning Calorimeter. The sample was prepared by transferring 0.4896 grams of sample from 92-05856 (labeled T-111, Core 33, Segment 2) to a glass vial. This sample was placed in a vacuum oven at 60°C and 28 in. Hg (711 mm Hg) at 1315 hours on December 9, 1993. The sample was removed from the oven at 1300 hours on December 10, 1993 and allowed to cool prior to weighing. The sample weight after this drying period was 0.0721 grams (a loss of 0.4175 grams or 85.3% mass loss). The sample was placed back in the oven at 60°C and 28 in. Hg at 1310 hours on December 10, 1993 and removed at 1500 hours on the same day. The sample was reweighed and a loss of only 0.0005 grams was observed; therefore, the sample was sealed and placed in a desiccator. The sample was analyzed on December 13, 1993 using a nitrogen gas environment. Samples of 11.19 and 15.72 milligrams were used for Runs 1 and 2, respectively. A temperature range from 35 to 550°C was scanned at 5°C/min. The results of these analyses are given in Table 1-1.

Table 1-1: Core 33, Segment 2, Energetics

RUN	RANGE (°C)	ONSET (°C)	ENTHALPY (J/g)
1	107 - 381	201	-898
2	113 - 394	196	-836

An indium and a zinc standard was run prior to analyzing the sample. The indium standard had an onset temperature of 156.8°C with an enthalpy of 28.3 J/g. The literature values for indium are 156.6°C and 28.45 J/g. The zinc standard had an onset temperature of 417.1°C with an enthalpy of 98.7 J/g. The literature values for zinc are 419.47°C and 108.37 J/g.

Thermogravimetric analysis was performed in triplicate on an aliquot of as-received sample material using a Perkin Elmer Model 2 Thermogravimetric Analyzer. A nitrogen gas environment was used to analyze these samples. Samples of 11.32, 17.11, and 19.40 milligrams were used for Runs 1, 2, and 3, respectively. Run 1 was performed on December 28, Run 2 on December 29, 1993, and Run 3 on January 3, 1994. A temperature range from 35 to 550°C was scanned at 5°C/min for Runs 1 and 2. The temperature range for Run 3 was from 35 to 200°C at a scan rate of 5°C/min. This shorter scan range was chosen, because no significant weight loss was observed above 150°C. The results of these analyses are given in Table 1-2.

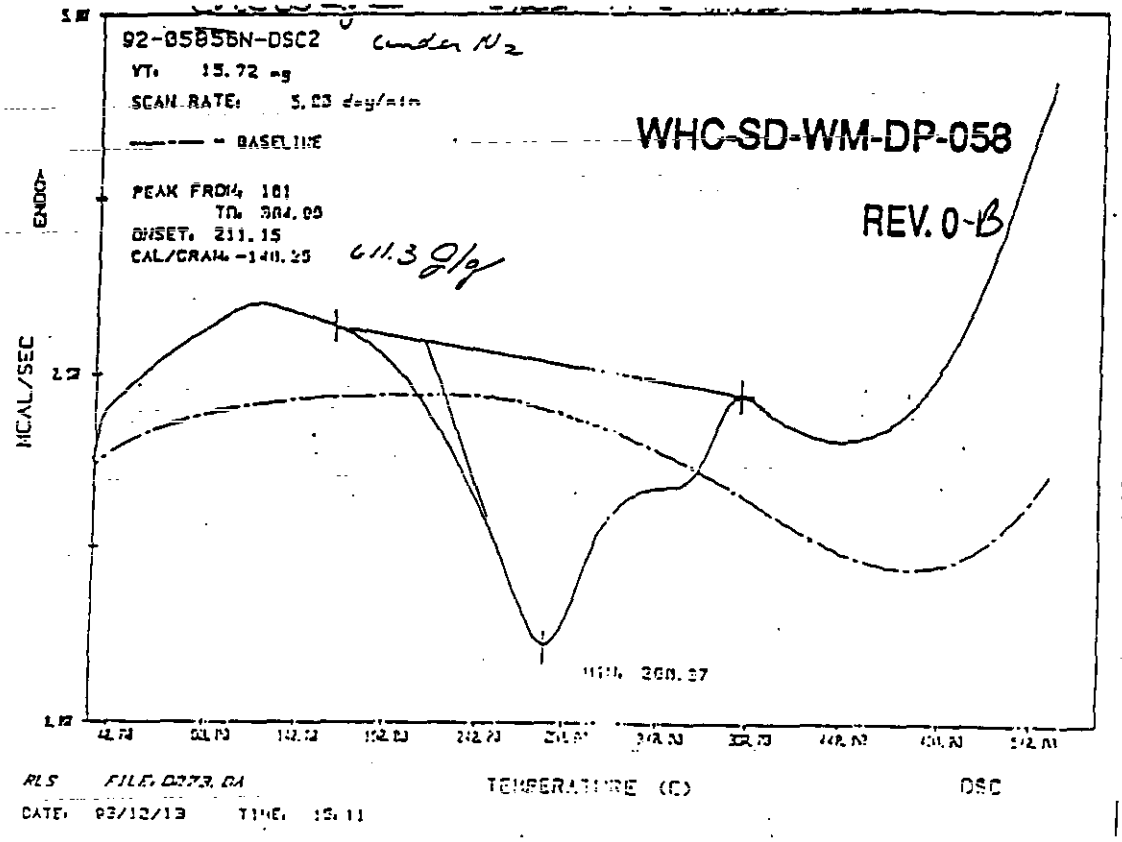
Table 1-2: Core 33, Segment 2, Mass Loss as a Function of Temperature

RUN	RANGE (°C)	WEIGHT LOSS (wt%)
1	31 - 103	67.3
2	31 - 116	80.3
3	30 - 130	79.7

Run 1 appeared to be on a sample that was significantly drier than the other samples. Runs 2 and 3 compare well with the gravimetric determinations weight percent solids measurements. It was also noted in Runs 1 and 2 that no significant weight loss was observed in the temperature range of the exothermic reaction.

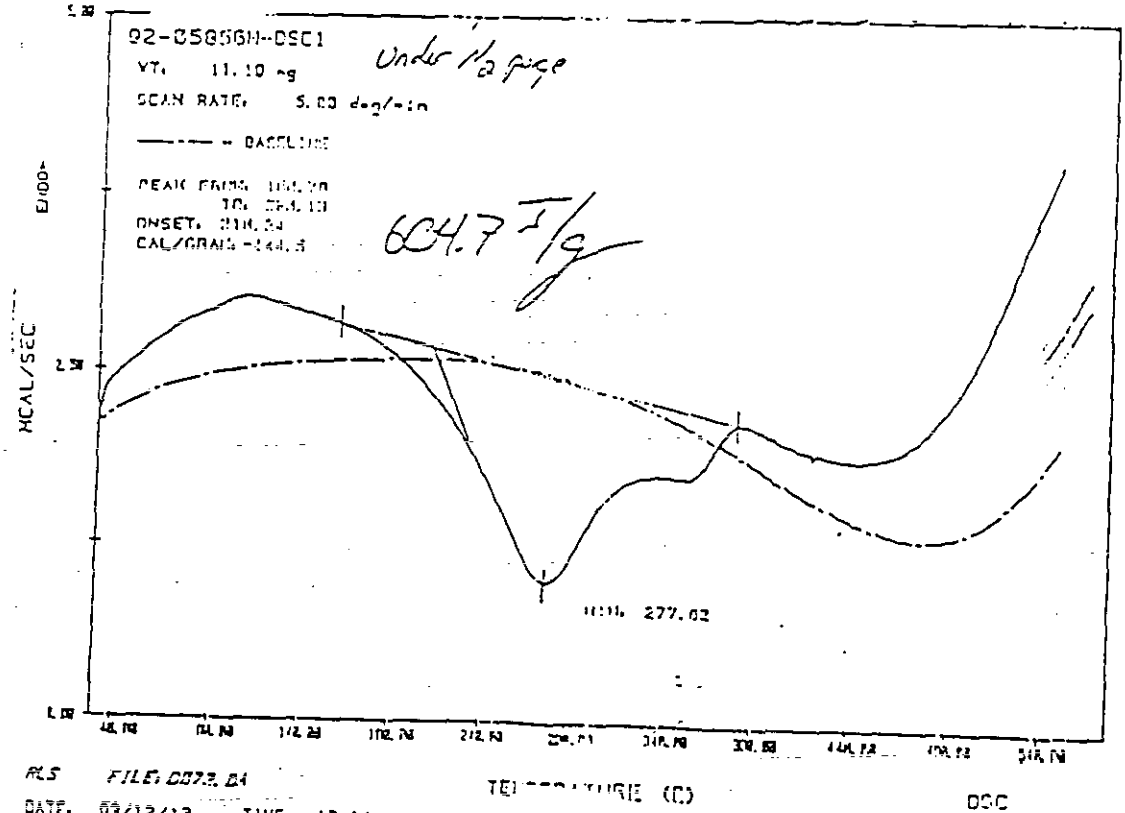
Alumel and perkalloy curie point standards were run prior to analyzing the sample. The alumel standard had an onset temperature of 162.35°C, and the perkalloy standard had an onset temperature of 595.73°C. The literature values for alumel and perkalloy are 163°C and 596°C, respectively.

Core 33 seg 2, dried sample run under a nitrogen purge 12/93



C01-004

Core 33 seg 2, dried sample run under a nitrogen purge 12/93



C04-002

Jan 3/24/94

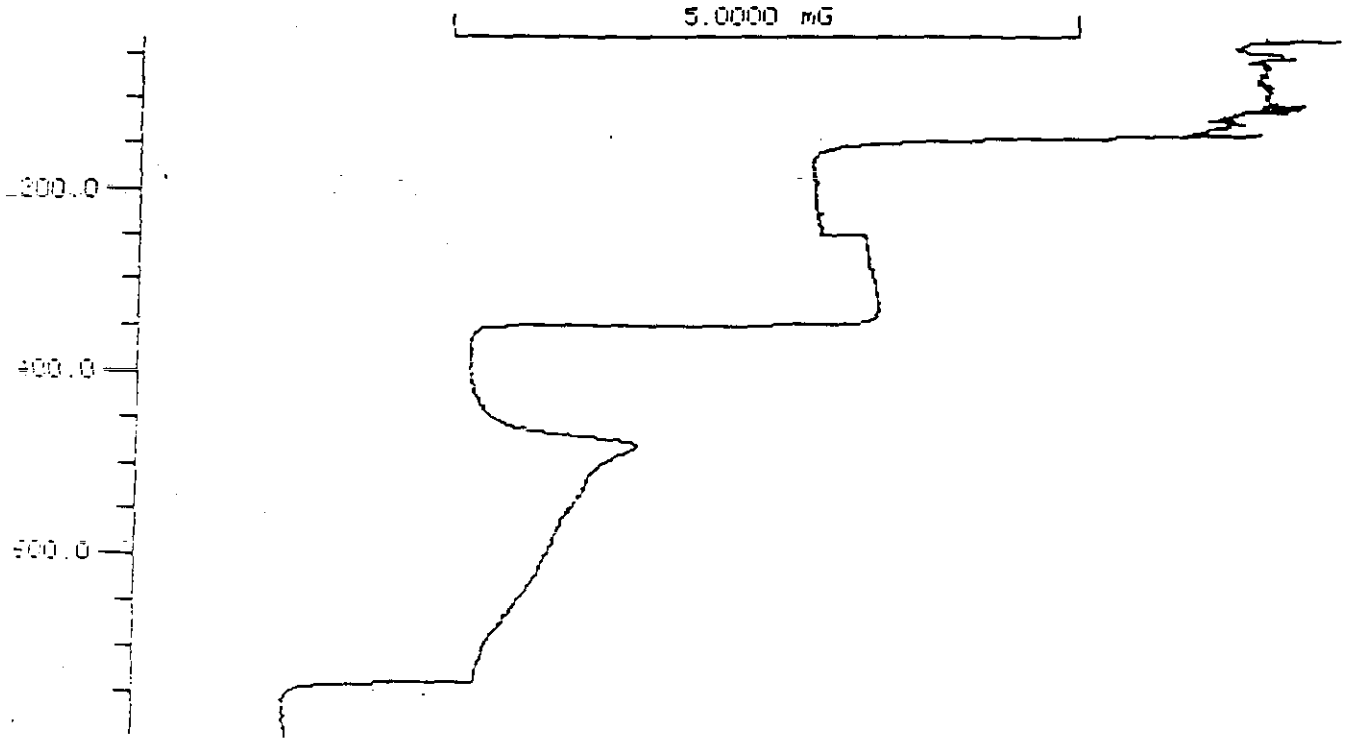
!@@!PPCALIBRATION 2

17-FEB-94 8:45

START TEMP.	°C	35
END TEMP.	°C	800
FILE NO.		00130.001
IDENT. NO.		0
WEIGHT	mG	6.7520

TEMPERATURE °C

WEIGHT GAIN----->



TEMP.	°C	143.67
TEMP.	°C	349.67
TEMP.	°C	739.00

James Lange 2/17/94

A	PT100	-22341
B	PT100	-.70428
C	PT100	-.05962

A-130

James Lange 2/17/94

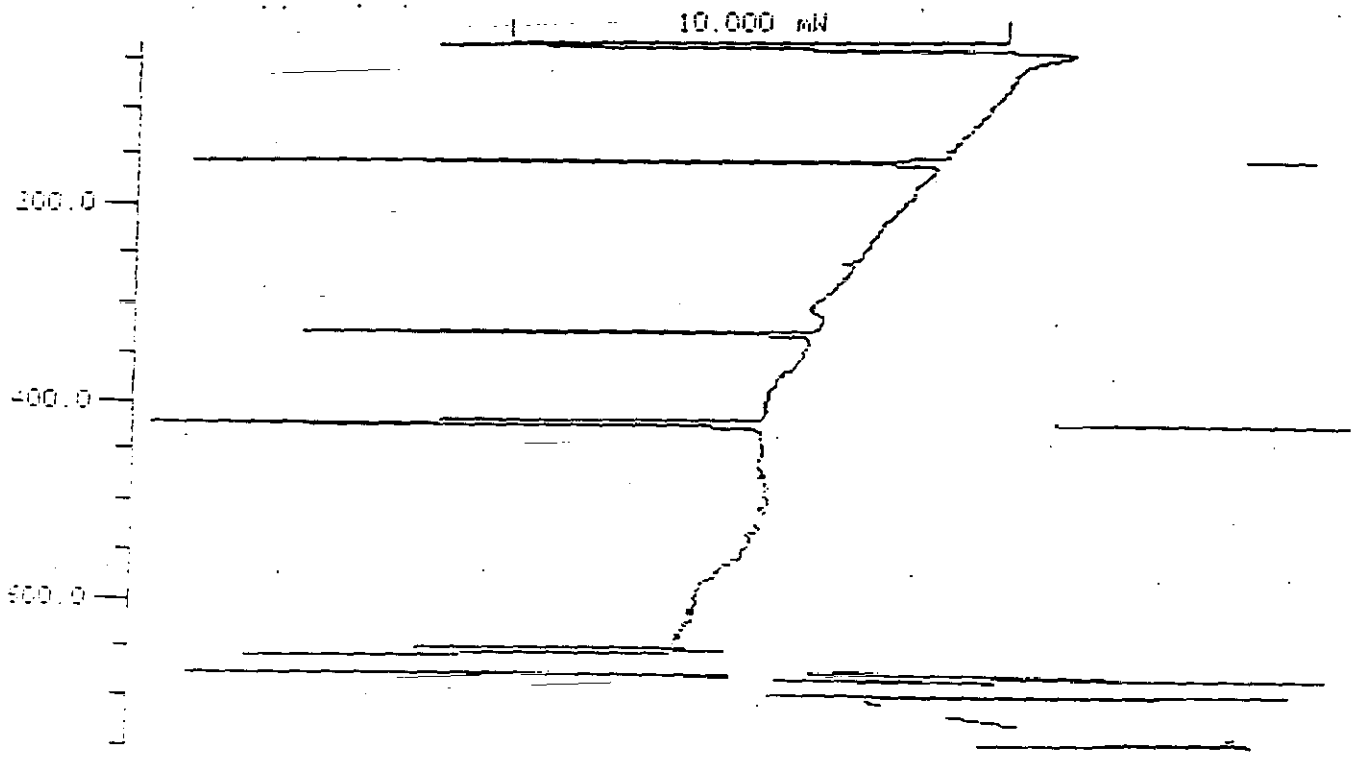
CALIBRATION 2

31-JAN-94 16:16

START TEMP.	°C	35
END TEMP.	°C	750.
FILE NO.		00120.001
IDENT. NO.		0
WEIGHT	mG	7.57

TEMPERATURE °C

HEAT FLOW
EXOTHERMAL-->



A	PT100	.21401
B	PT100	.75726
C	PT100	-.12421
E	INDIUM	310.23

******** METTLER TA4000 SYSTEM *********

1/31/94

WHC-SD-WM-DP-058
REV. 0-B

ADDITIONAL DATA SUBMITTED ON 05/18/94

WESTINGHOUSE HANFORD COMPANY

WHC-SD-WM-DP-058 REV. 0-A/B

222-S LABORATORY

ANALYTICAL BATCH

Lab Segment Serial No. J1668-72	Customer ID: 1240-D-A,B,C,D,E
Analysis: DSC	Sample Prep: DIRECT

Instrument: WC16134	Procedure/ Rev: LA 514-113/B-0
Technologist: R. WENDLAND	Date: 05/~~03~~02/94 5/2/94
Starting Time: 0600	Temperature N/A
Ending Time: 2300	Chemist: J. FRYE

Comments:

	Description	Lab ID
1	LMCS	J1667-5511
2	SAMPLE	J1668-5711
3	DUP	J1668-5811
4	SAMPLE	J1669-5711
5	DUP	J1669-5811
6	SAMPLE	J1670-5711
7	DUP	J1670-5811
8	SAMPLE	J1671-5711
9	DUP	J1671-5811
10	SAMPLE	J1672-5711

	Description	Lab ID
11	DUP	J1672-5811
12		
13		
14		
15		
16		
17		
18		
19		
20		

~~Standard~~ Type	Primary Book No. and Aliquot Vol.	Second Book No. and Aliquot Vol.	Third Book No. and Aliquot Vol.	Final Vol. of Standard
LMCS	12N14-A			

WHC-SD-WM-DP-058
REV. 0-A/B
Nov 5/24/94

DON'T SAY IT ... *Write It!*

DATE 5/4/94

TO Data Handling FROM J. M. Luyo

Batch 3364

The DSC exotherms in these T-111 samples were very broad. The right end of the exother was easily seen, but the left end merged into the water endotherm. The plots provided are optimized plots. The runs were all done to 500°C.

Joan M. Luyo
5/4/94

WHC-SD-WM-DP-058

REV. 0-A/B Rev 5/24/94

DIFFERENTIAL SCANNING CALORIMETRY ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH Boiler 3364

Serial No	Sample Point	Date	Time Issued	Priority
J 1667.-5511	T111-C33-S2	5- 2-94	11:54	14

Determination	Method Standard	Result Units	Charge Code	Reruns
DSC	LA-514-113	% RECOVERY	N54D2	0

Sample Size	Customer ID
6.680 mg	STD

Remarks, Calculations, Results:

Indium Std.

27.19 J/g 95.3 % Recovery

27.39 J/g 96.0 % Recovery

Std # 12W14-A

Robby Wendland

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	23:00	J.M. Fayfield

54-5800-061 (R-10-93)

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1668.-5711	T111-C33-S2	5- 2-94	11:57	14

Determination	Method Standard	Result Units	Charge Code	Reruns
DSC	LA-514-113	EXOTHERMS	N54D2	0

Sample Size	Customer ID
16.957 mg	1240-D-A

Remarks, Calculations, Results:

251.2 J/g exotherm

Robby Wendland

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	J.M. Fayfield

54-5800-061 (R-10-93)

DIFFERENTIAL SCANNING CALORIMETRY ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1668.-5811	T111-C33-S2	5- 2-94	11:57	14

Determination	Method Standard	Result Units	Charge Code	Reruns
DSC	LA-514-113	EXOTHERMS	N54D2	0

Sample Size	Customer ID
13.267 mg	1240-D-A

Remarks, Calculations, Results
DUPLICATE SAMPLE

269.0 J/g exotherm

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr	
5-2-94	2300	GM Fryxell	

5-2-94 RW

54-6800-061 (R-10-831)

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1669.-5711	T111-C33-S2	5- 2-94	12: 0	14

Determination	Method Standard	Result Units	Charge Code	Reruns
DSC	LA-514-113	EXOTHERMS	N54D2	0

Sample Size	Customer ID
12.576 mg	1240-D-B

Remarks, Calculations, Results

309.2 J/g exotherm

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr	
5-2-94	2300	GM Fryxell	

54-6800-061 (R-10-831)

WHC-SD-WM-DP-058

REV. 0-KB New 5/24/94

DIFFERENTIAL SCANNING CALORIMETRY ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1669.-5811	T111-C33-S2	5- 2-94	12: 0	14

Determination	Method Standard	Result Units	Charge Code	Reruns
DSC	LA-514-113	EXOTHERMS	N54D2	0

Sample Size: 18.182 mg

Customer ID: 1240-D-B

Remarks, Calculations, Results:
DUPLICATE SAMPLE

287.5 J/g exotherm

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	J. M. Fayfield

54-6800-061 (R-10-83)

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1670.-5711	T111-C33-S2	5- 2-94	12: 1	14

Determination	Method Standard	Result Units	Charge Code	Reruns
DSC	LA-514-113	EXOTHERMS	N54D2	0

Sample Size: 5.897 mg

Customer ID: 1240-D-C

Remarks, Calculations, Results:

180.2 J/g exotherm

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	J. M. Fayfield

54-6800-061 (R-10-83)

WHC-SD-WM-DP-058

Rev. 0-A 5/24/94

DIFFERENTIAL SCANNING CALORIMETRY ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH

Serial No.	Sample Point	Date	Time Issued	Priority
J 1670.-5811	T111-C33-S2	5- 2-94	12: 1	14

Determination	Method Standard	Result Units	Charge Code	Returns
DSC	LA-514-113	EXOTHERMS	N54D2	0

Sample Size	Customer ID
6.179 mg	1240-D-C

Remarks, Calculations, Results

DUPLICATE SAMPLE

187.1 J/g exotherm

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	J. M. Fayfe

54-6800-061 (R-10-83)

SUPER RUSH

Serial No.	Sample Point	Date	Time Issued	Priority
J 1671.-5711	T111-C33-S2	5- 2-94	12: 2	14

Determination	Method Standard	Result Units	Charge Code	Returns
DSC	LA-514-113	EXOTHERMS	N54D2	0

Sample Size	Customer ID
6.696 mg	1240-D-D

Remarks, Calculations, Results

162.7 J/g exotherm

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	J. M. Fayfe

54-6800-061 (R-10-83)

WHC-SD-WM-DP-058
Rev. 0-KB JAW 5/24/94

DIFFERENTIAL SCANNING CALORIMETRY ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1671.-5811	T111-C33-S2	5- 2-94	12: 2	14

Determination	Method/Standard	Result Units	Charge Code	Reruns
DSC	LA-514-113	EXOTHERMS	N54D2	0

Sample Size: 7.023 mg

Customer ID: 1240-D-D

Remarks, Calculations, Results:
DUPLICATE SAMPLE

175.3 J/g exotherm

Robby Wendland

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	J. M. Fayfield

54-6800-061 (R-10-83)

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1672.-5711	T111-C33-S2	5- 2-94	12: 3	14

Determination	Method/Standard	Result Units	Charge Code	Reruns
DSC	LA-514-113	EXOTHERMS	N54D2	0

Sample Size: 7.740 mg

Customer ID: 1240-D-E

Remarks, Calculations, Results:

336.2 J/g exotherm

Robby Wendland

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	J. M. Fayfield

54-6800-061 (R-10-83)

WHC-SD-WM-DP-058
REV. 0-A 15 HW 5/4/94

DIFFERENTIAL SCANNING CALORIMETRY ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1672.-5811	T111-C33-S2	5- 2-94	12: 3	14

Determination	Method Standard	Result Units	Charge Code	Returns
DSC	LA-514-113	EXOTHERMS	N54D2	0

Sample Size	Customer ID
6.154 mg	1240-D-E

Remarks, Calculations, Results
DUPLICATE SAMPLE

335.9 J/g exotherm

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

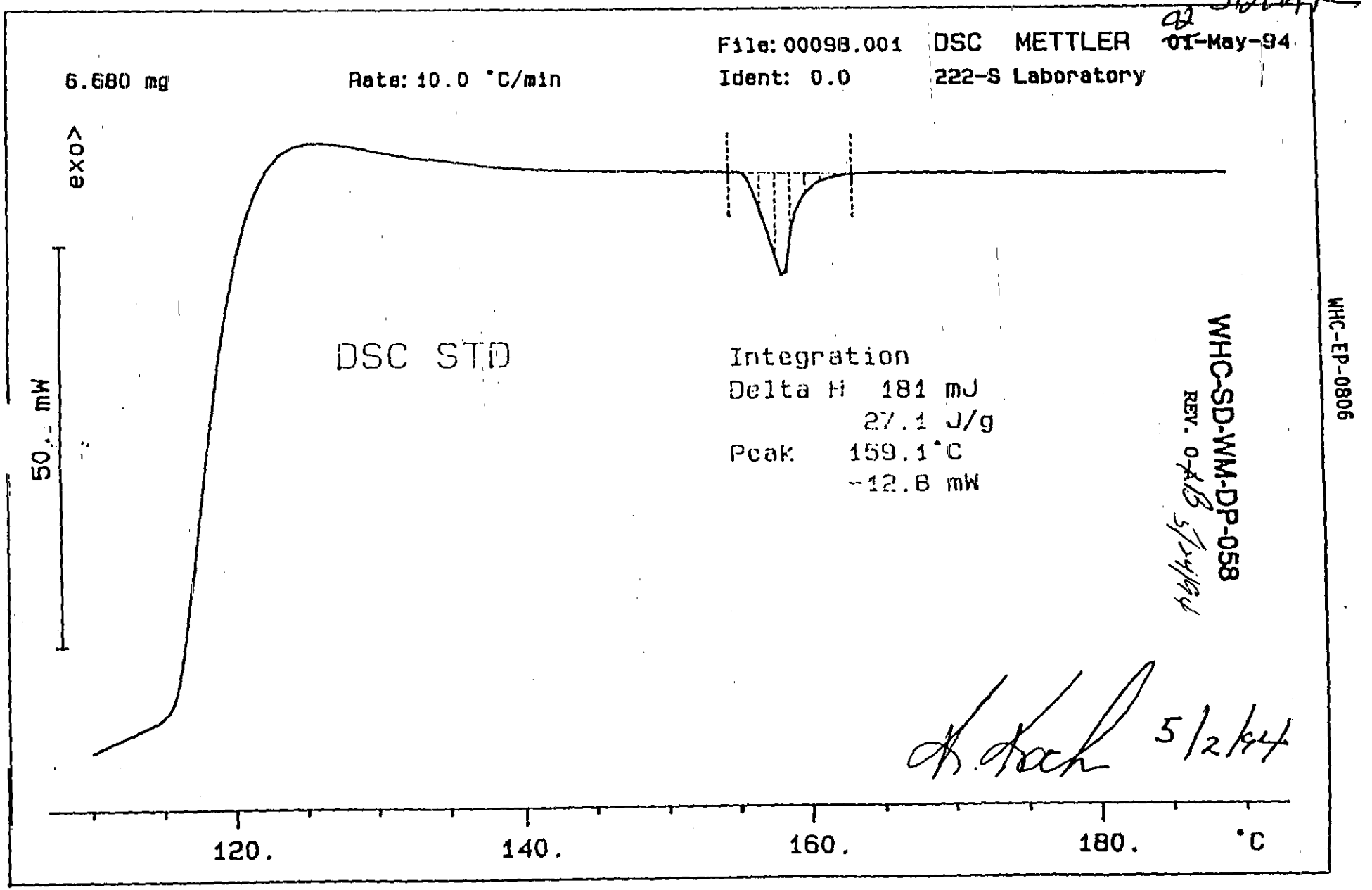
Date	Time Completed	Lab Unit Mgr	
5-2-94	2300		

54-6800-061 (R-10-83)

BEST AVAILABLE COPY

Signature below represents chemical technologist/chemist that completed/verified the calibration/analysis on pages 105 to 116.

5/2/94 K

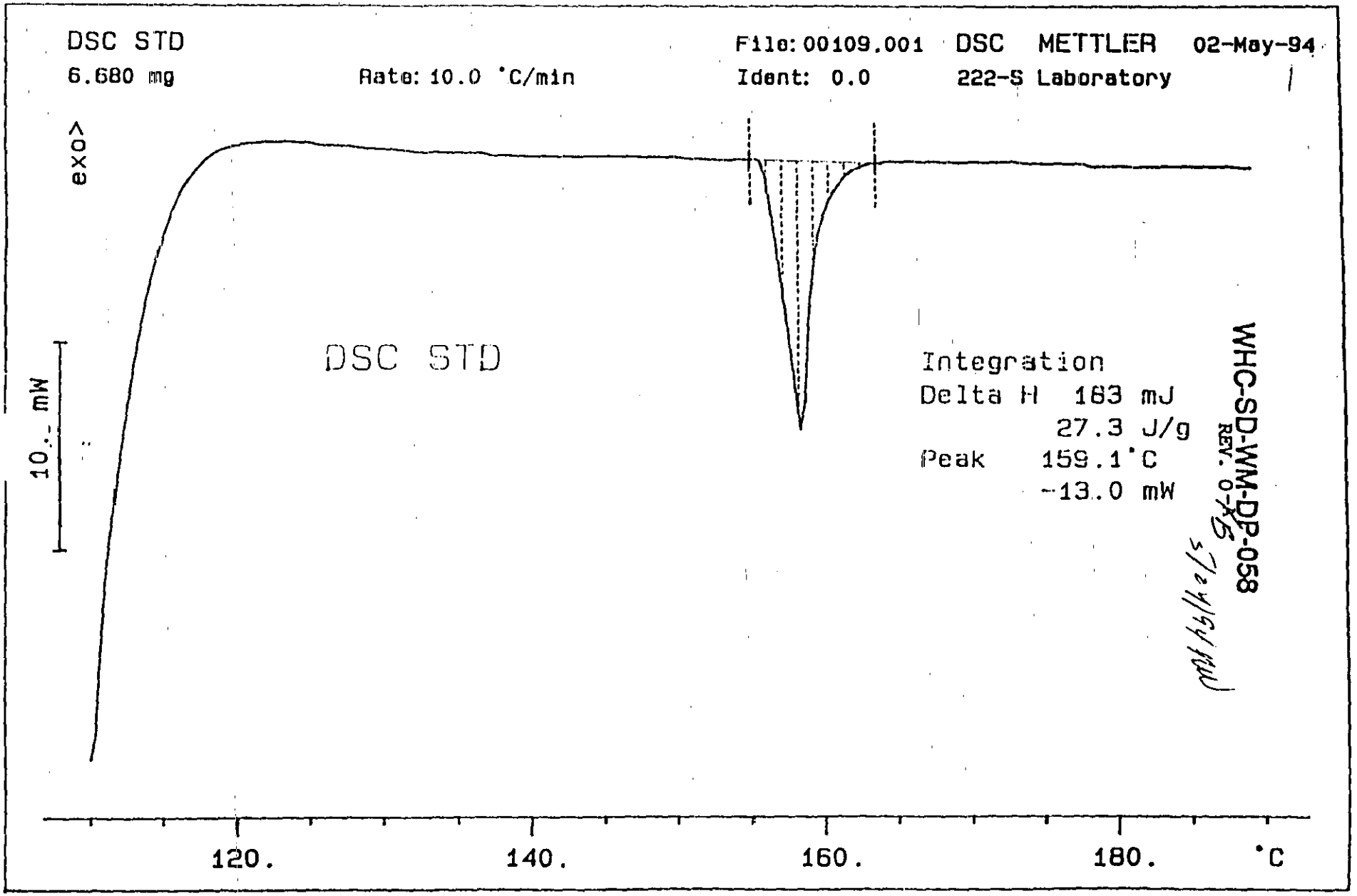


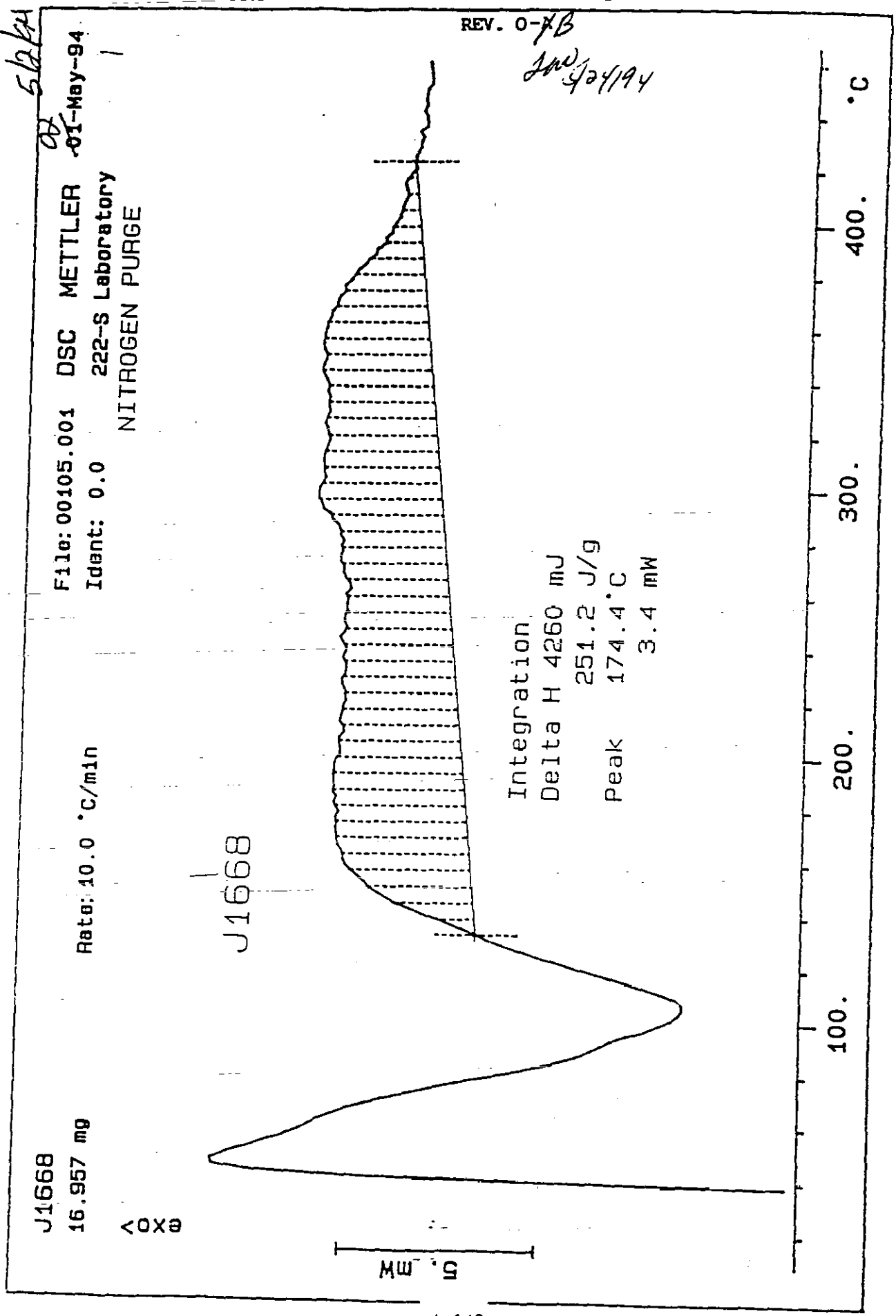
WHC-SD-WM-DP-058
REV. 0 AB 5/2/94

WHC-EP-0806

A-141

5/2/94


DSC STD
6.680 mg
Rate: 10.0 °C/min
File: 00109.001 DSC METTLER 02-May-94
Ident: 0.0 222-S Laboratory
exo>
10.- mW
DSC STD
Integration
Delta H 183 mJ
27.3 J/g
Peak 159.1 °C
-13.0 mW
120.
140.
160.
180.
°C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Ident: 0.0 222-S Laboratory
NITROGEN PURGE
Rate: 10.0 °C/min
J1668
16.957 mg
J1668
Integration
Delta H 4260 mJ
251.2 J/g
Peak 174.4°C
3.4 mW
5. mW
exo>
100.
200.
300.
400.
°C

5/2/94

J1668 DUP

13.267 mg

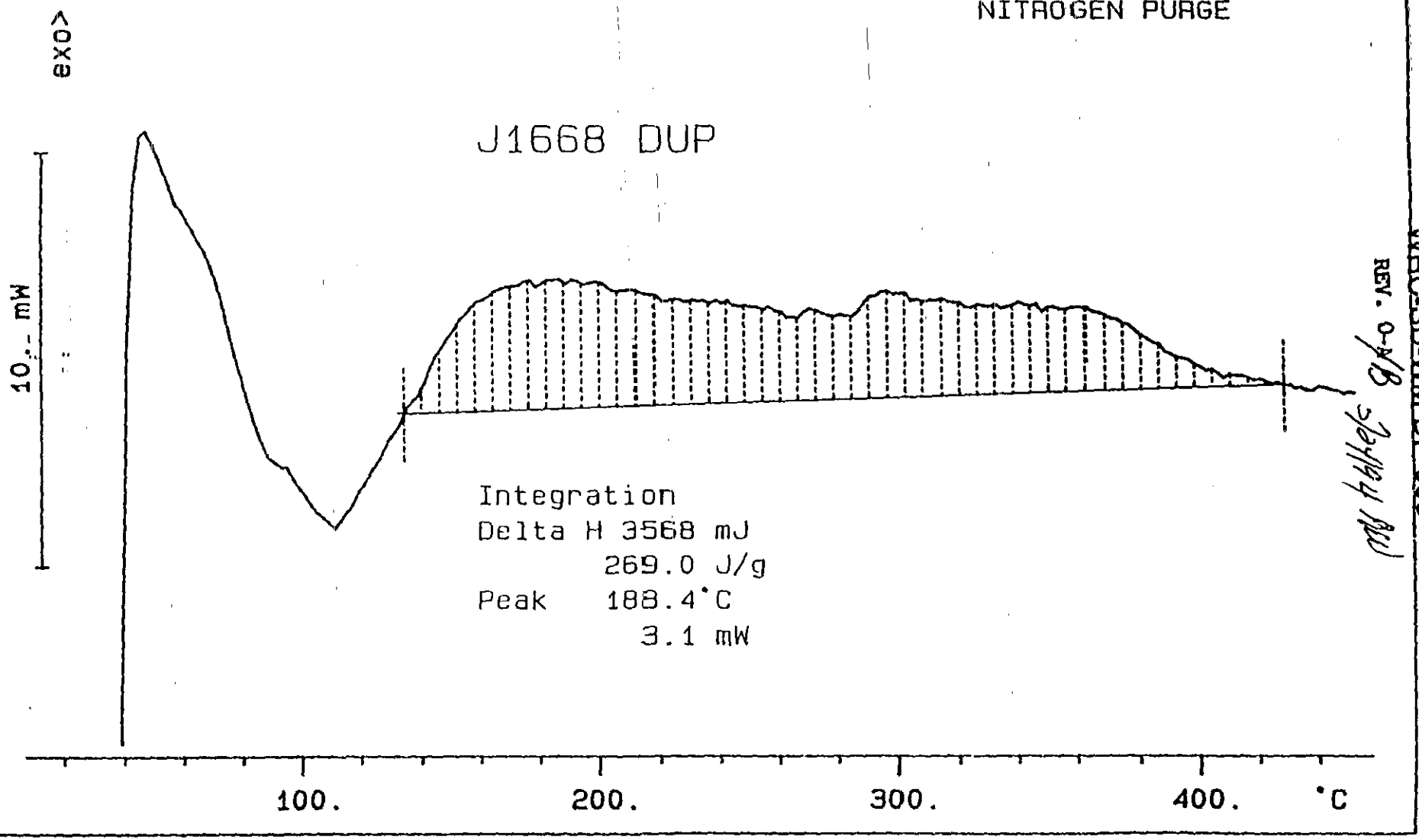
Rate: 10.0 °C/min

File: 00107.001 DSC METTLER 01-May-94

Ident: 0.0 222-S Laboratory

NITROGEN PURGE

O2 N2

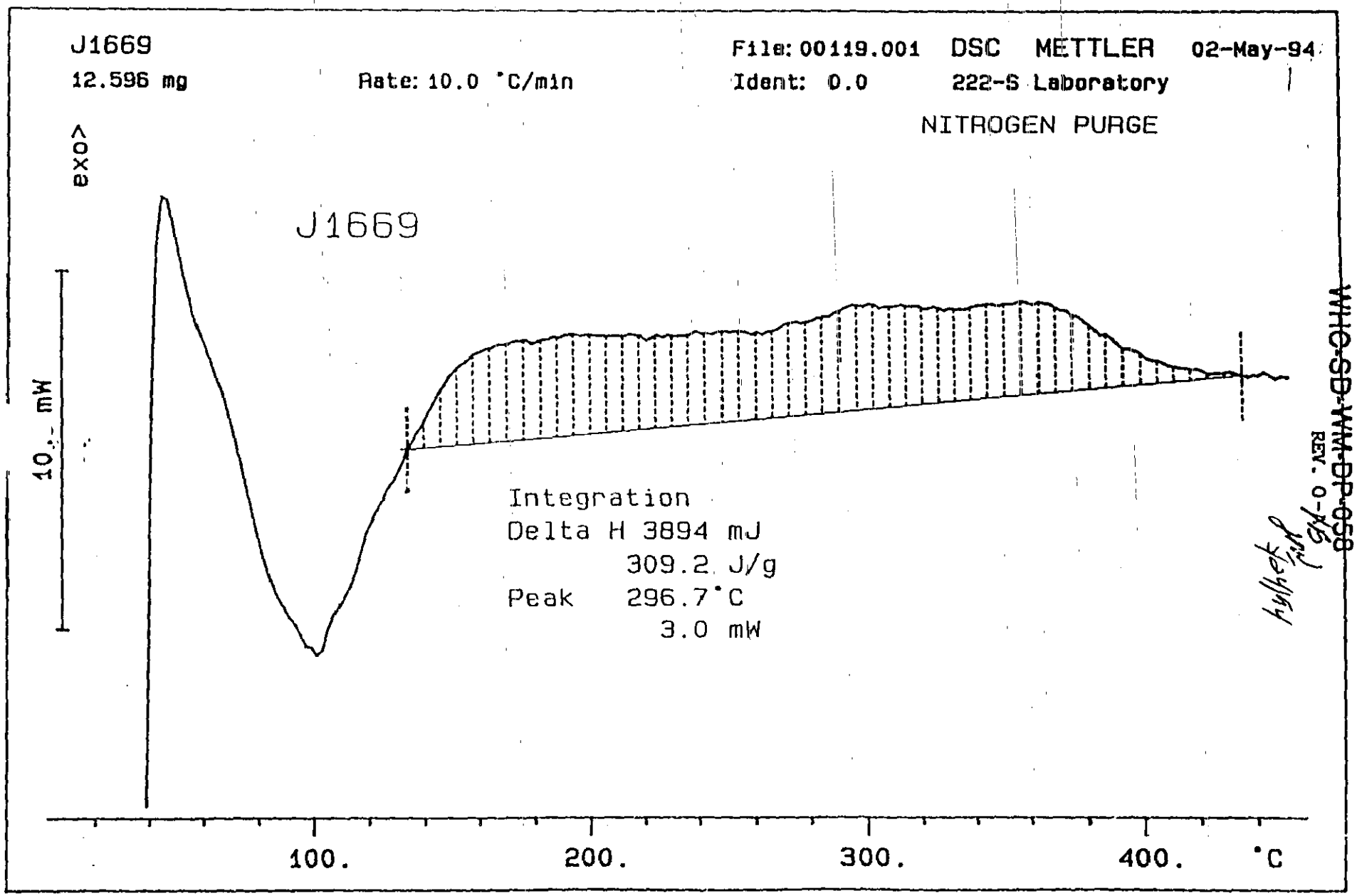


A-144

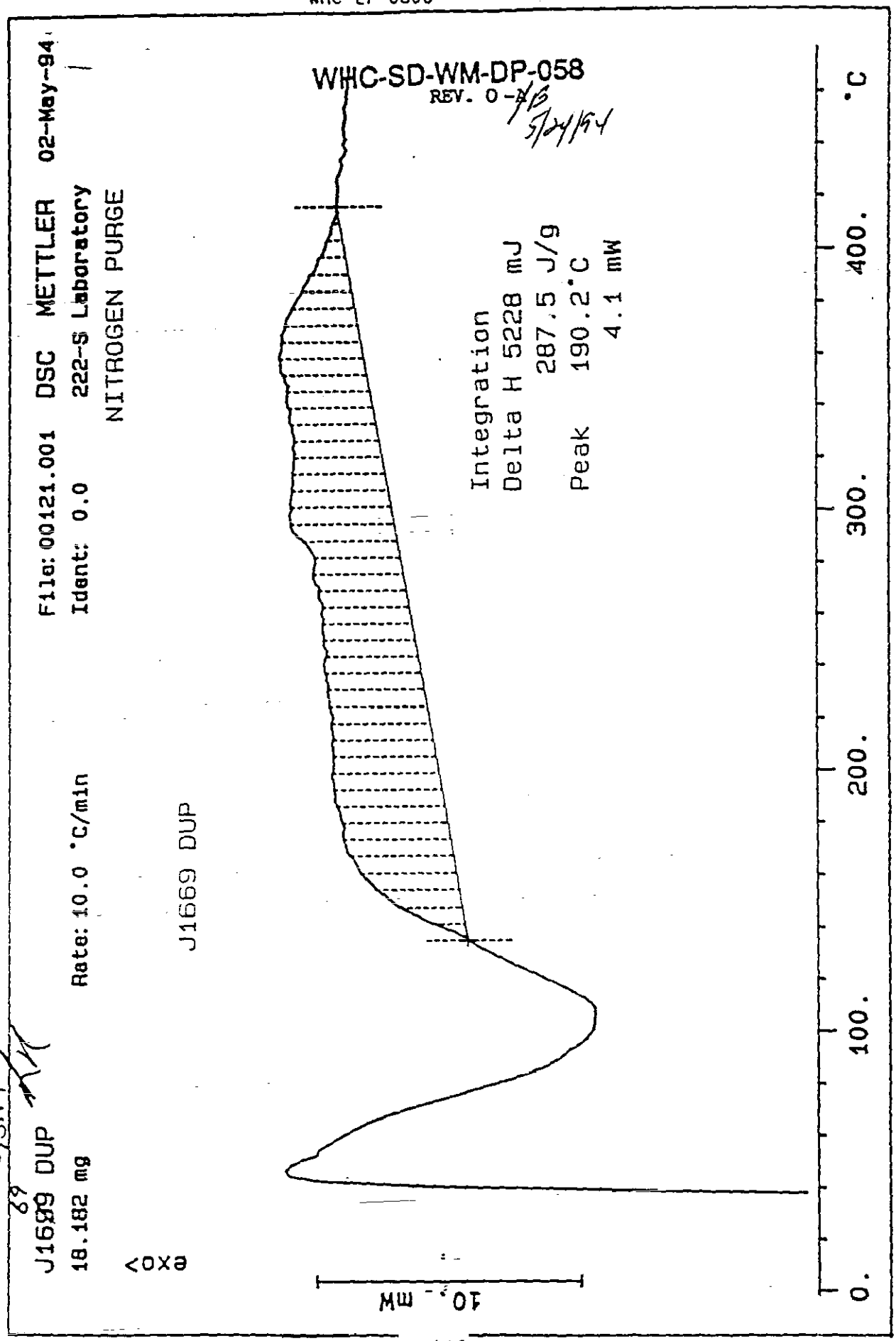
WHC-SD-WM-DP-058 REV. 0-A/B

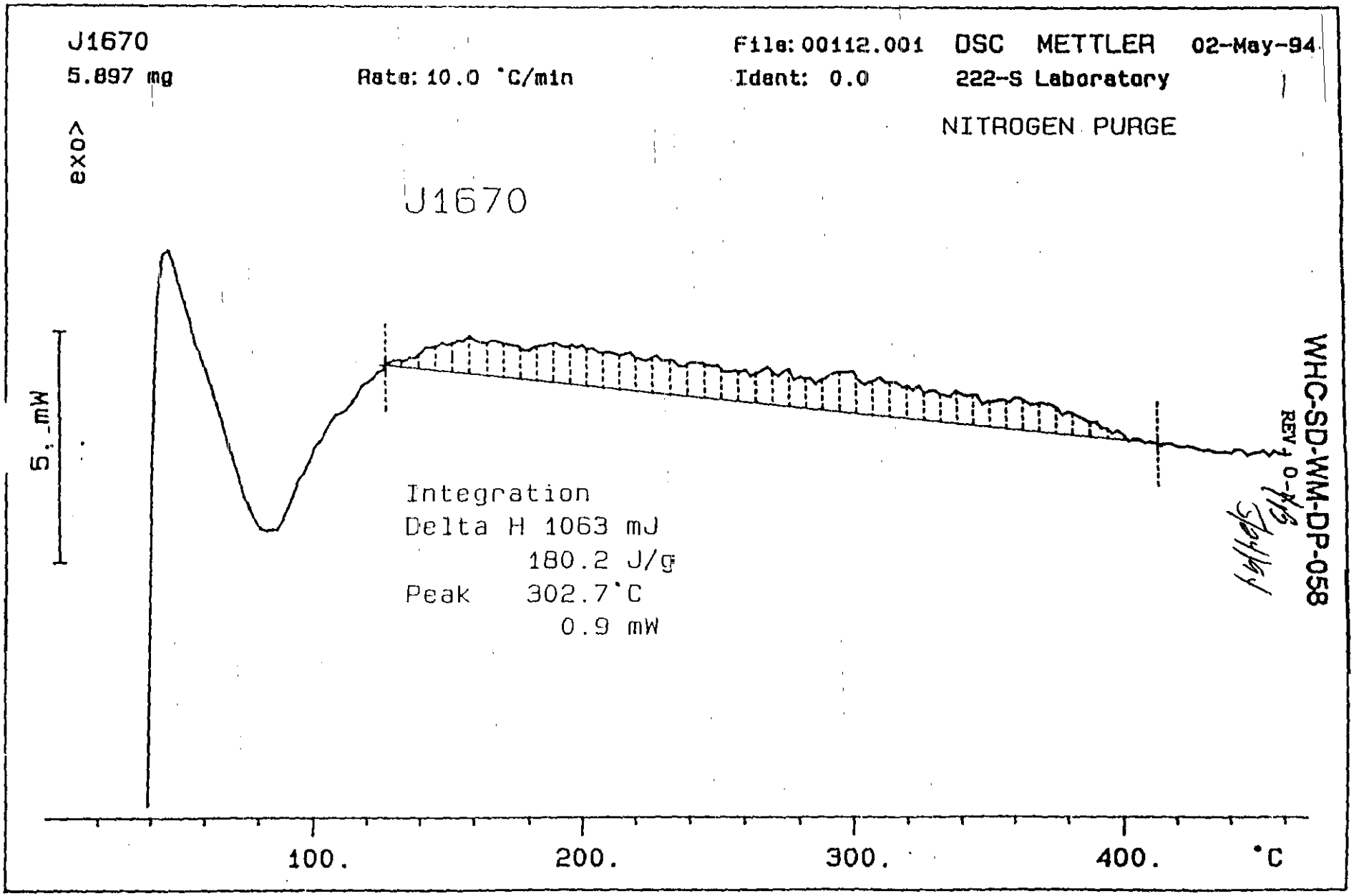
WHC-EP-0806

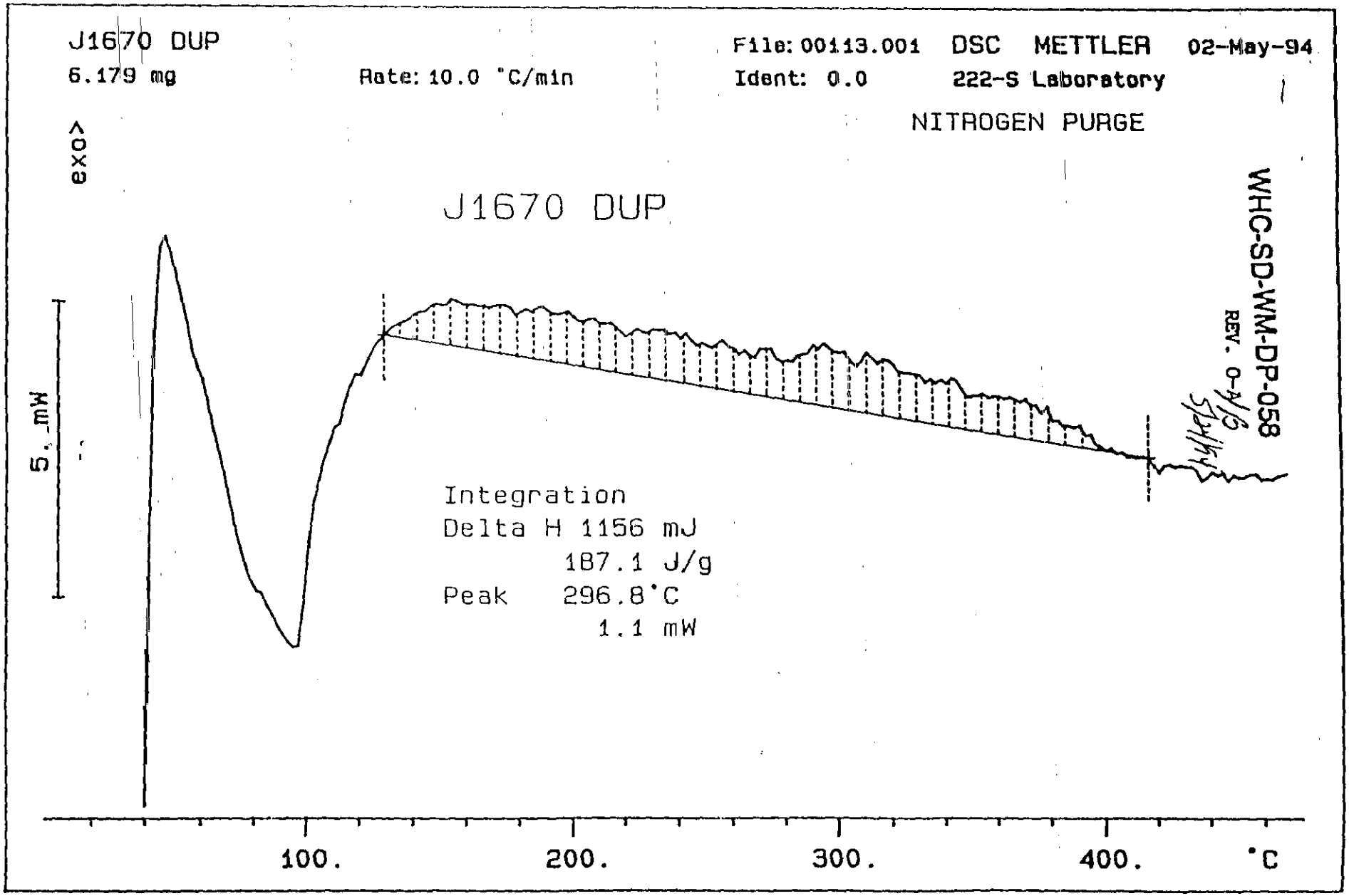
5/2/94 RW



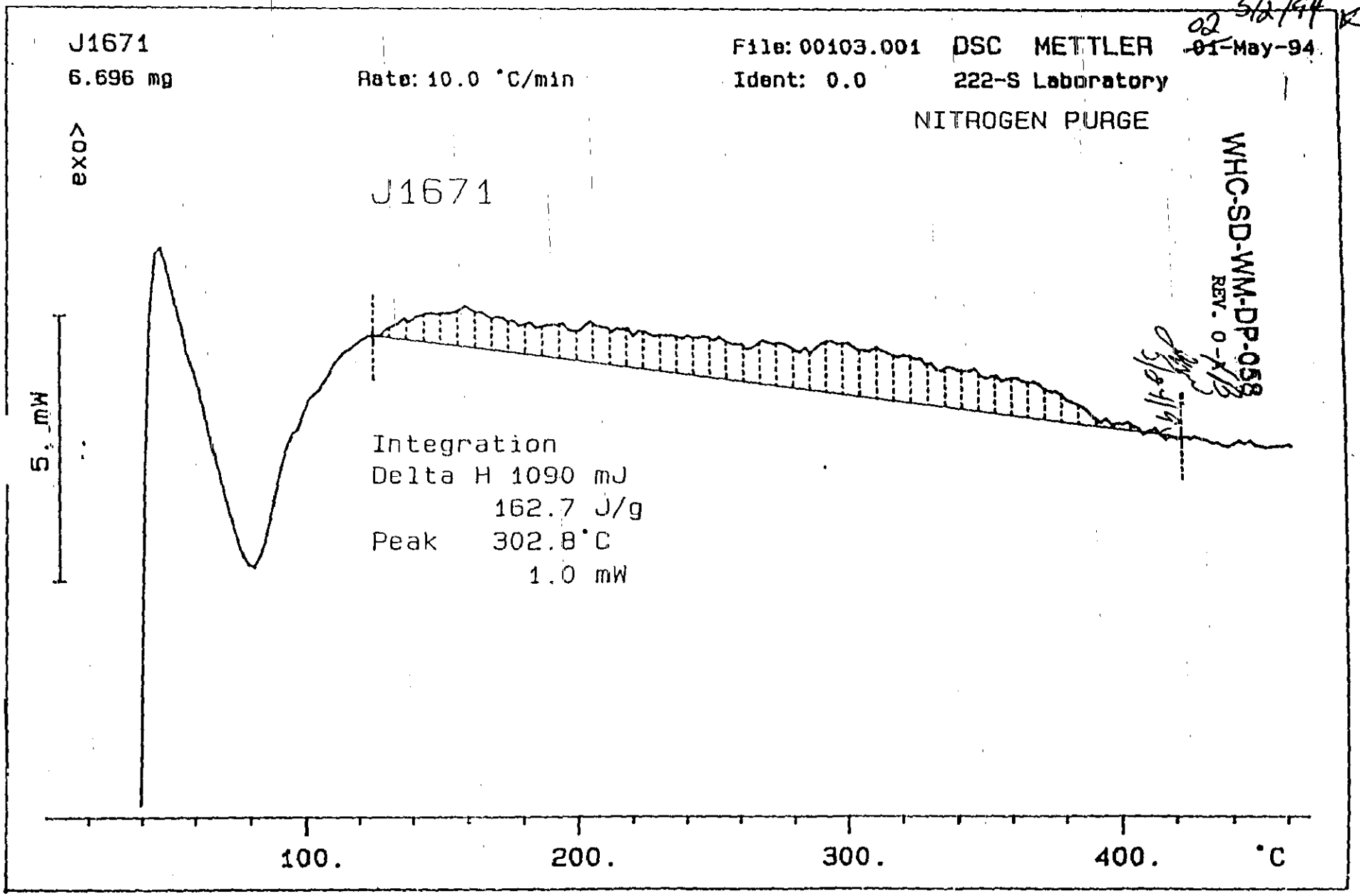
WHC-SD-WM-DP-058
REV. 0-A
WHC-EP-0806


WHC-SD-WM-DP-058
REV. 0-A
5/24/94
File: 00121.001 DSC METTLER 02-May-94
Ident: 0.0 222-S Laboratory
NITROGEN PURGE
Rate: 10.0 °C/min
J1669 DUP
J1669 DUP
18.182 mg
5/5/94
Integration
Delta H 5228 mJ
287.5 J/g
Peak 190.2°C
4.1 mW
exo>
10 mW
0.
100.
200.
300.
400.
°C


J1670
5.897 mg
Rate: 10.0 °C/min
File: 00112.001
Ident: 0.0
DSC METTLER
222-S Laboratory
02-May-94
NITROGEN PURGE
exo>
J1670
5. mW
Integration
Delta H 1063 mJ
180.2 J/g
Peak 302.7°C
0.9 mW
100.
200.
300.
400.
°C



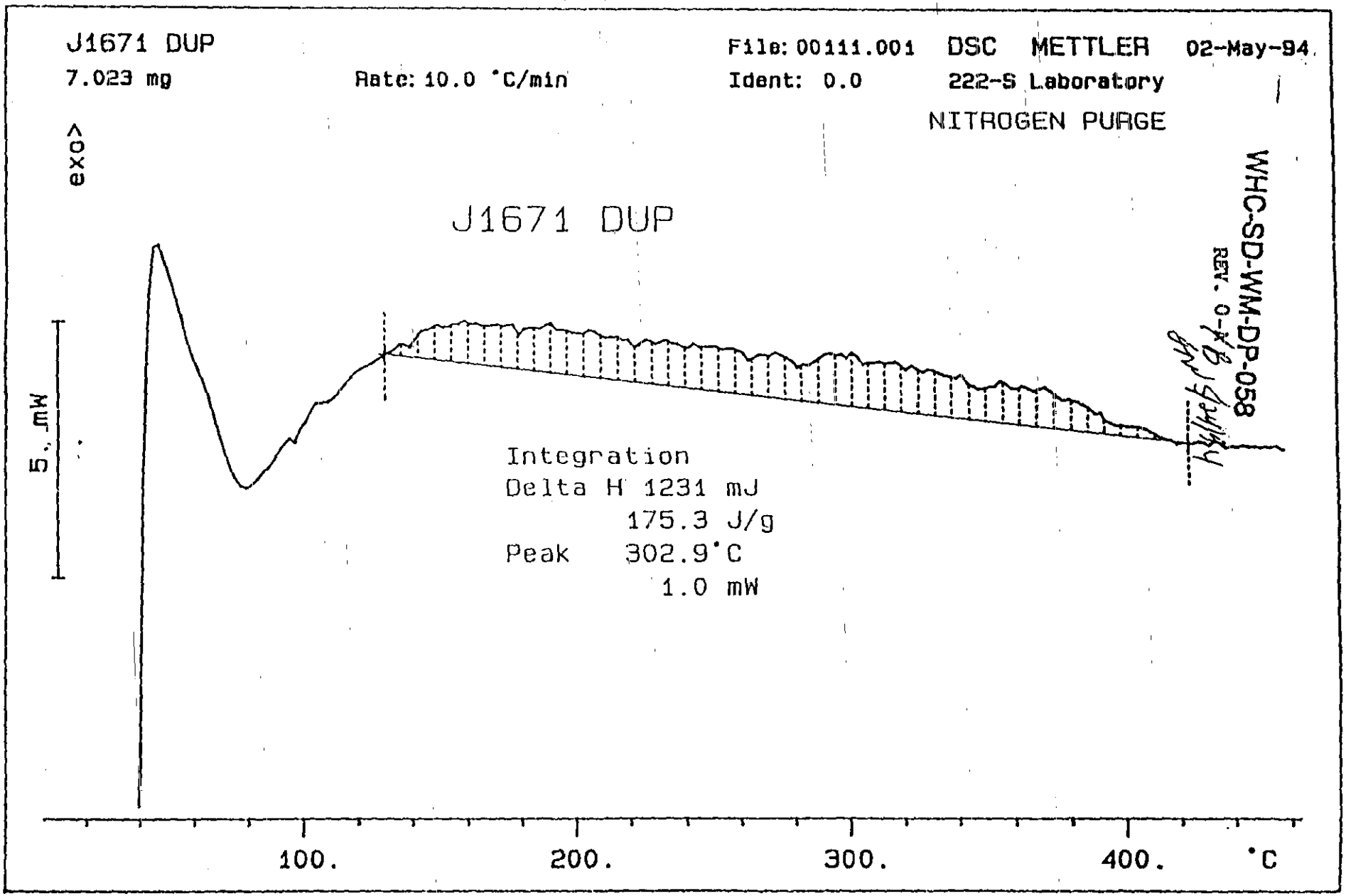
WHC-SD-WM-DP-058
REV. 0-A/B

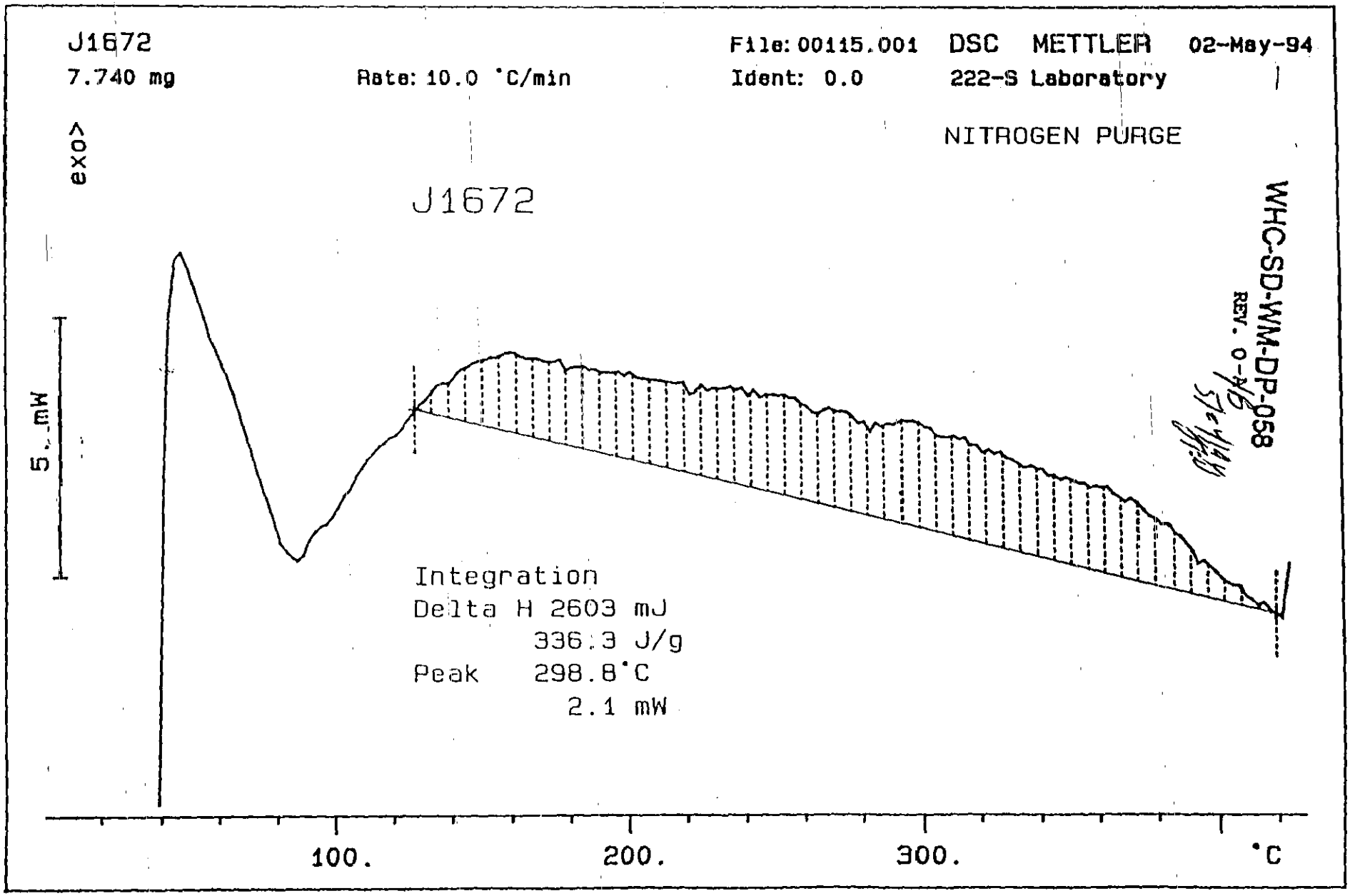


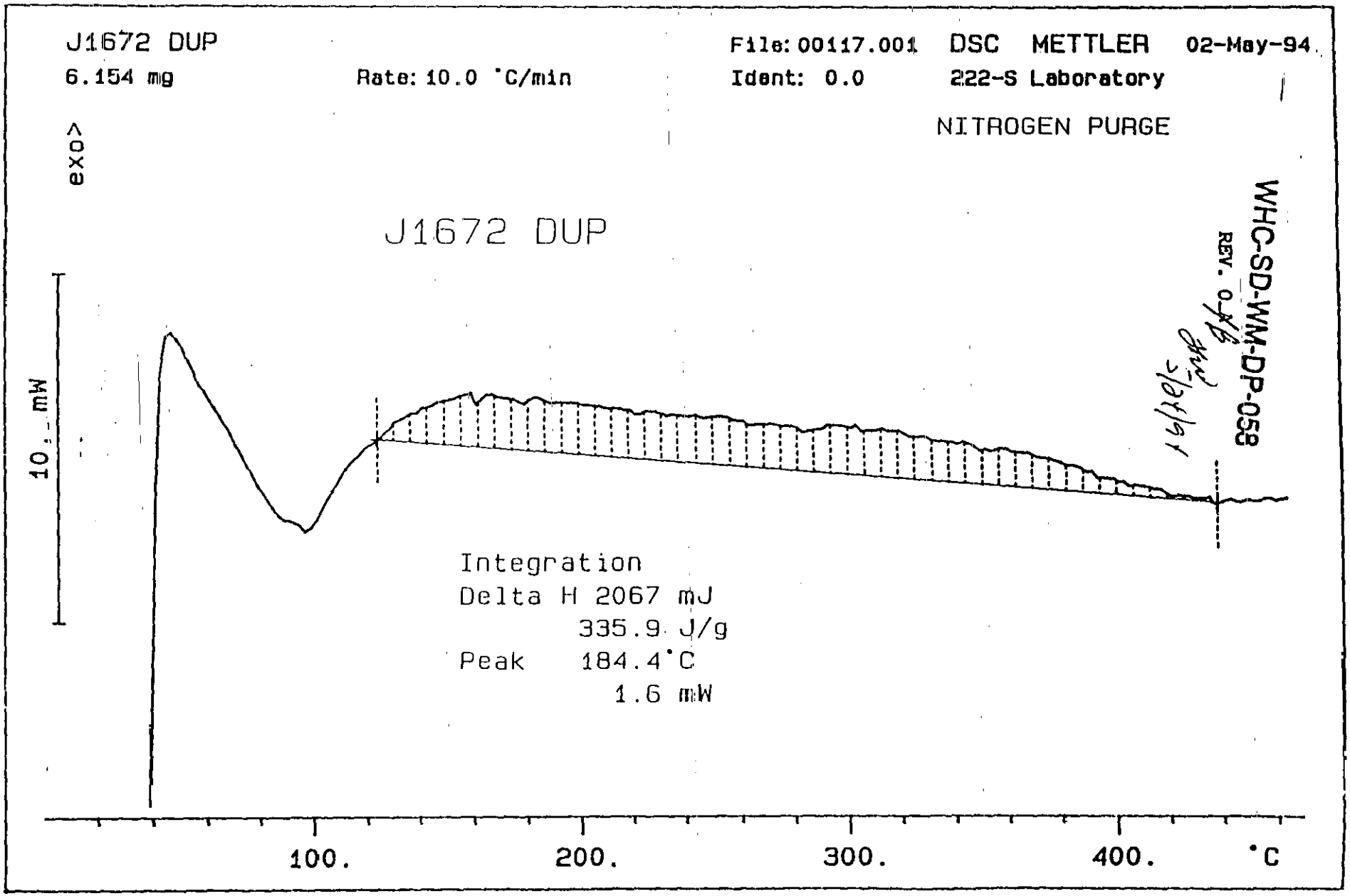
WHC-SD-WM-DP-058
REV. 0

WHC-EP-0806

A-149


J1671 DUP
7.023 mg
Rate: 10.0 °C/min
File: 00111.001 DSC METTLER 02-May-94
Ident: 0.0 222-S Laboratory
NITROGEN PURGE
exo>
J1671 DUP
5. mW
Integration
Delta H 1231 mJ
175.3 J/g
Peak 302.9°C
1.0 mW
100.
200.
300.
400.
°C


J1672
7.740 mg
Rate: 10.0 °C/min
File: 00115.001
Ident: 0.0
DSC METTLER
222-S Laboratory
02-May-94
NITROGEN PURGE
exo>
J1672
5. mW
Integration
Delta H 2603 mJ
336.3 J/g
Peak 298.8°C
2.1 mW
100.
200.
300.
°C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6.154 mg
Rate: 10.0 °C/min
File: 00117.001
Ident: 0.0
DSC METTLER
222-S Laboratory
02-May-94
NITROGEN PURGE
exo
J1672 DUP
10. mW
Integration
Delta H 2067 mJ
335.9 J/g
Peak 184.4°C
1.6 mW
100.
200.
300.
400.
°C

WESTINGHOUSE HANFORD COMPANY

WHC-SD-WM-DP-058

REV. 0-A/B

222-S LABORATORY

ANALYTICAL BATCH

Lab Segment Serial No. J1668-72 5/24/94	Customer ID: 1240-D-A,B,C,D,E
Analysis: TGA	Sample Prep: DIRECT

Instrument: WC16130	Procedure/ Rev: LA 560-112/A-1
Technologist: R. WENDLAND	Date: 05/~~03~~02/94 5/24/94
Starting Time: 600	Temperature N/A
Ending Time: 2300	Chemist: J. FRYE

Comments: _____

	Description	Lab ID
1	LMCS	J1667-5512
2	SAMPLE	J1668-5712
3	DUP	J1668-5812
4	SAMPLE	J1669-5712
5	DUP	J1669-5812
6	SAMPLE	J1670-5712
7	DUP	J1670-5812
8	SAMPLE	J1671-5712
9	DUP	J1671-5812
10	SAMPLE	J1672-5712

	Description	Lab ID
11	DUP	J1672-5812
12		
13		
14		
15		
16		
17		
18		
19		
20		

Standard Type	Primary Book No. and Aliquot Vol.	Second Book No. and Aliquot Vol.	Third Book No. and Aliquot Vol.	Final Vol. of Standard
LMCS	24N8-A			

WHC-SD-WM-DP-058

REV. 0-A/B 5/24/94

THERMAL GRAVIMETRIC ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH Batch 3365

Serial No	Sample Point	Date	Time Issued	Priority
J 1667.-5512	T111-C33-S2	5- 2-94	11:54	14

Determination	Method Standard	Result Units	Charge Code	Returns
TGA	LA-560-112	% RECOVERY	N54D2	0

Sample Size	Customer ID
16.955 mg	STD

Remarks, Calculations, Results

58.7% H_2O 99.1% Recovery

Robby Wendland STD# 24198-A

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	J. M. Fuyo

54-6830-061 (R-10-831)

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1668.-5712	T111-C33-S2	5- 2-94	11:57	14

Determination	Method Standard	Result Units	Charge Code	Returns
TGA	LA-560-112	% H2O	N54D2	0

Sample Size	Customer ID
11.928 mg	1240-D-A

Remarks, Calculations, Results

11.67% H_2O

Robby Wendland

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	J. M. Fuyo

54-6830-061 (R-10-831)

WHC-SD-WM-DP-058
REV. 0-A B 5/24/94

THERMAL GRAVIMETRIC ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1668.-5812	T111-C33-S2	5- 2-94	11:57	14

Determination	Method Standard	Result Units	Charge Code	Reruns
TGA	LA-560-112	% H2O	N54D2	0

Sample Size	Customer ID
15.604 mg	1240-D-A

Remarks, Calculations, Results

DUPLICATE SAMPLE

10.06 % H_2O

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr	
5-2-94	2300	Q. M. Fuyo	

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1669.-5712	T111-C33-S2	5- 2-94	12: 0	14

Determination	Method Standard	Result Units	Charge Code	Reruns
TGA	LA-560-112	% H2O	N54D2	0

Sample Size	Customer ID
17.548 mg	1240-D-B

Remarks, Calculations, Results

10.66 % H_2O

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr	
5-2-94	2300	Q. M. Fuyo	

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 5/24/94 JRW

THERMAL GRAVIMETRIC ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH

Serial No.	Sample Point	Date	Time Issued	Priority
J 1669.-5812	T111-C33-S2	5- 2-94	12: 0	14

Determination	Method Standard	Result Units	Charge Code	Reruns
TGA	LA-560-112	% H20	N54D2	0

Sample Size	Customer ID
19.760 mg	1240-D-B

Remarks, Calculations, Results
DUPLICATE SAMPLE

9.90% H_2O

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	G M. Lyon

SUPER RUSH

Serial No.	Sample Point	Date	Time Issued	Priority
J 1670.-5712	T111-C33-S2	5- 2-94	12: 1	14

Determination	Method Standard	Result Units	Charge Code	Reruns
TGA	LA-560-112	% H20	N54D2	0

Sample Size	Customer ID
6.338 mg	1240-D-C

Remarks, Calculations, Results

11.35% H_2O.

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	G M. Lyon

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REV. 0-A 5/24/94

THERMAL GRAVIMETRIC ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1670.-5812	T111-C33-S2	5- 2-94	12: 1	14

Determination	Method Standard	Result Units	Charge Code	Reruns
TGA	LA-560-112	% H20	N54D2	0

Sample Size	Customer ID
8.043mg	1240-D-C

Remarks, Calculations, Results

DUPLICATE SAMPLE

11.99 % H_2O

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	G.M. Fuyo

54-6800-061 (R-10-83)

SUPER RUSH

Serial No	Sample Point	Date	Time Issued	Priority
J 1671.-5712	T111-C33-S2	5- 2-94	12: 2	14

Determination	Method Standard	Result Units	Charge Code	Reruns
TGA	LA-560-112	% H20	N54D2	0

Sample Size	Customer ID
7.786mg	1240-D-D

Remarks, Calculations, Results

12.07 % H_2O

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	G.M. Fuyo

54-6800-061 (R-10-83)

WHC-SD-WM-DP-058
Rev. 0-A 5/24/94 HW

THERMAL GRAVIMETRIC ANALYSIS - UNDIGESTED SAMPLE

GUIDED DIGU

Serial No.	Sample Point	Date	Time Issued	Priority
J 1671.-5812	T111-C33-S2	5- 2-94	12: 2	14

Determination	Method Standard	Result Units	Charge Code	Reruns
TGA	LA-560-112	% H2O	N54D2	0

Sample Size	Customer ID
5.750 mg	1240-D-D

Remarks, Calculations, Results:
DUPLICATE SAMPLE

12.08% H_2O

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	G. M. Fryer

54-6800-061 (R-10-83)

GUIDED DIGU

Serial No.	Sample Point	Date	Time Issued	Priority
J 1672.-5712	T111-C33-S2	5- 2-94	12: 3	14

Determination	Method Standard	Result Units	Charge Code	Reruns
TGA	LA-560-112	% H2O	N54D2	0

Sample Size	Customer ID
7.101 mg	1240-D-E

Remarks, Calculations, Results:

11.21% H_2O

ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
Hrs	Hrs	Hrs	Hrs	Hrs

Date	Time Completed	Lab Unit Mgr
5-2-94	2300	G. M. Fryer

54-6800-061 (R-10-83)

WHC-SD-WM-DP-058

REV. 0-KB 5/24/94 New

THERMAL GRAVIMETRIC ANALYSIS - UNDIGESTED SAMPLE

SUPER RUSH

Serial No.	Sample Point	Date	Time Issued	Priority
J 1672.-5812	T111-C33-S2	5- 2-94	12: 3	14

Determination	Method Standard	Result Units	Charge Code	Reruns
TGA	LA-560-112	% H2O	N54D2	0

Sample Size	Customer ID
9.313 mg	1240-D-E

Remarks, Calculations, Results

DUPLICATE SAMPLE

11.10% H_2O

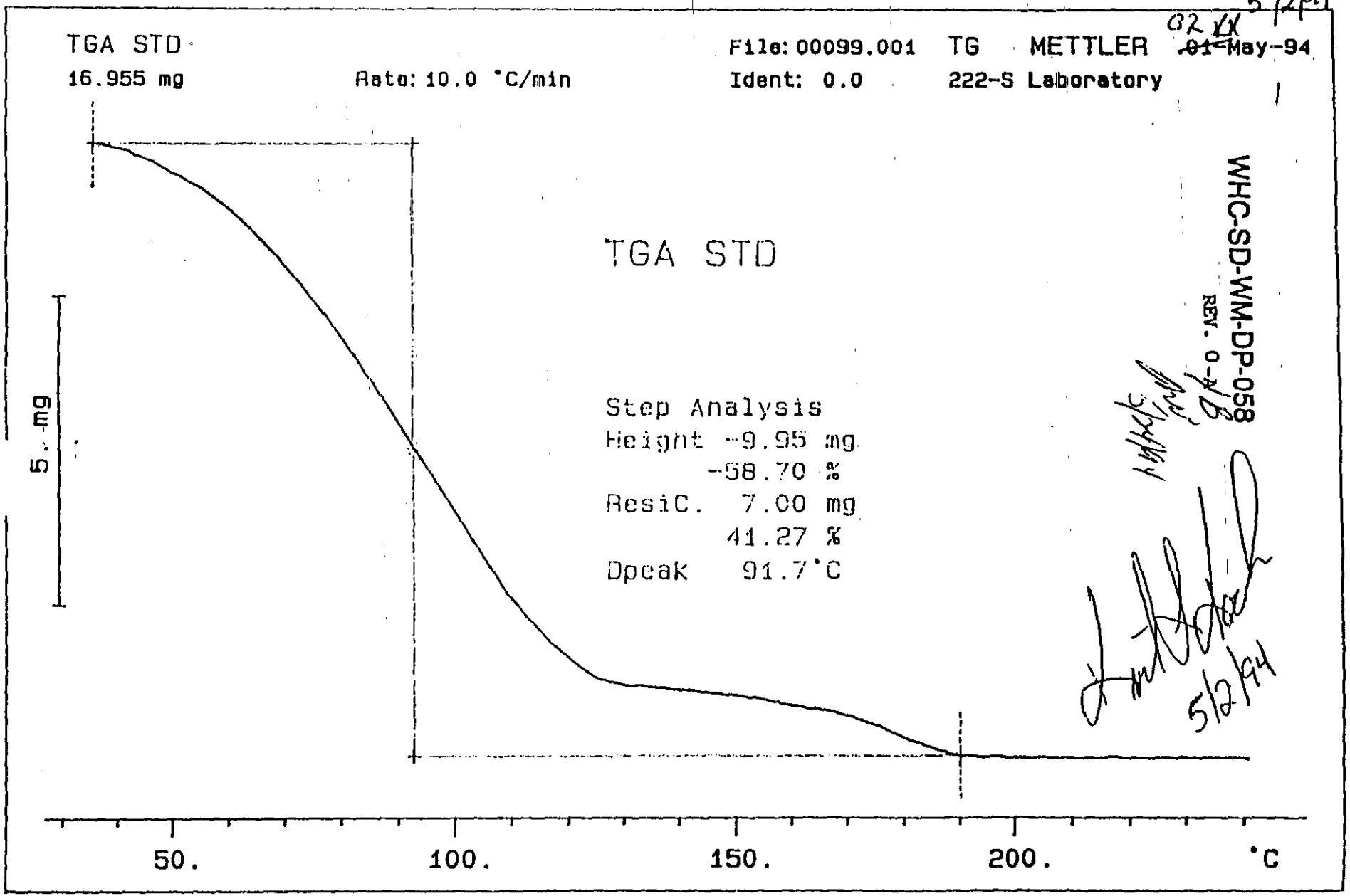
ROBBY WENDLAND

Analyst - 1	Analyst - 2	Analyst - 3	Analyst - 4	Analyst - 5
hrs	hrs	hrs	hrs	hrs

Date	Time Completed	Lab Unit Mgr	
5-2-94	2300	G.M. Fagan	

Signature below represents chemical Technologist/chemist that completed/verified the calibration/analysis on page 124 to 135 .

5/2/94



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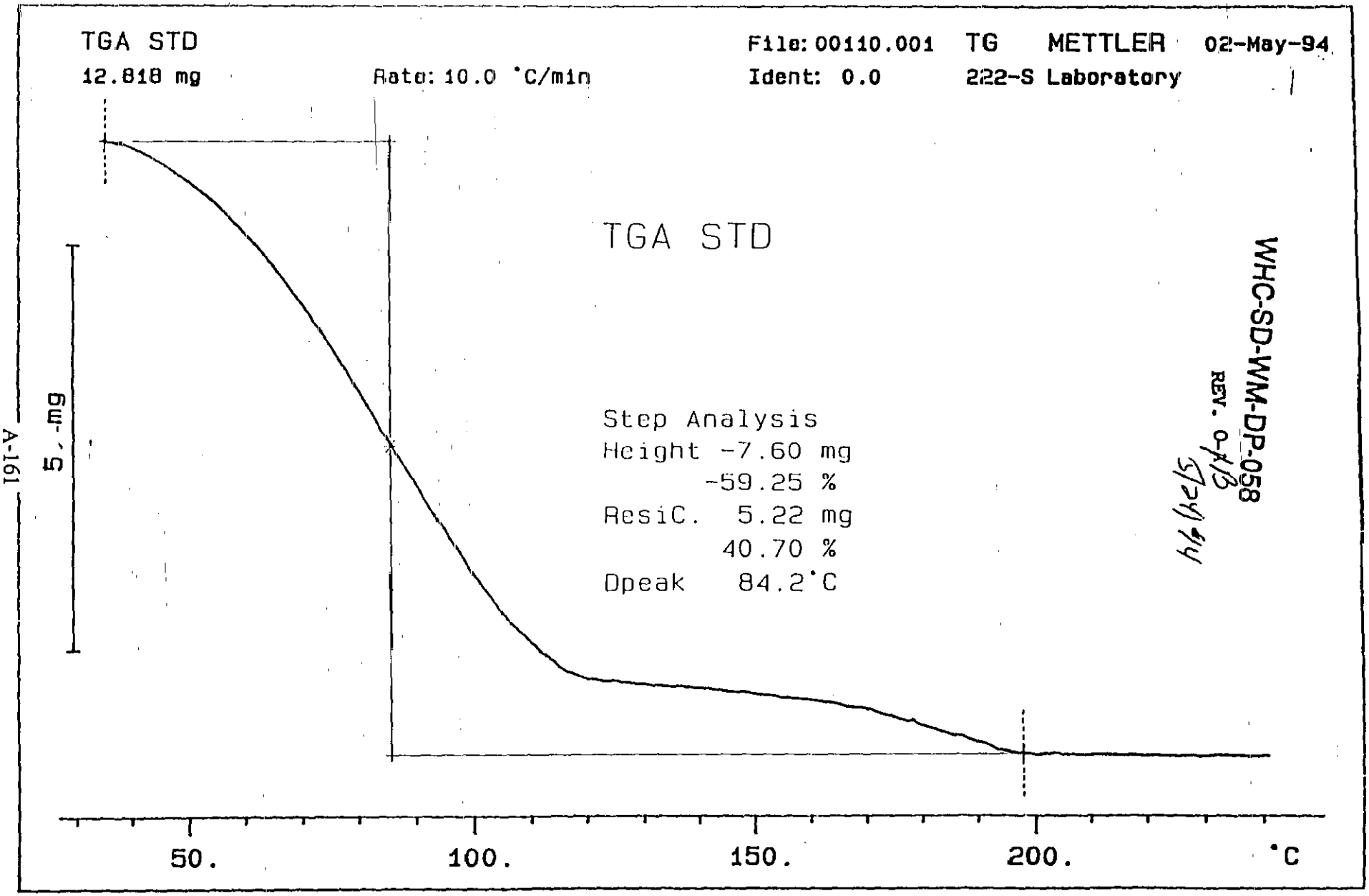
WHC-SD-WM-DP-058
REV. 0-A

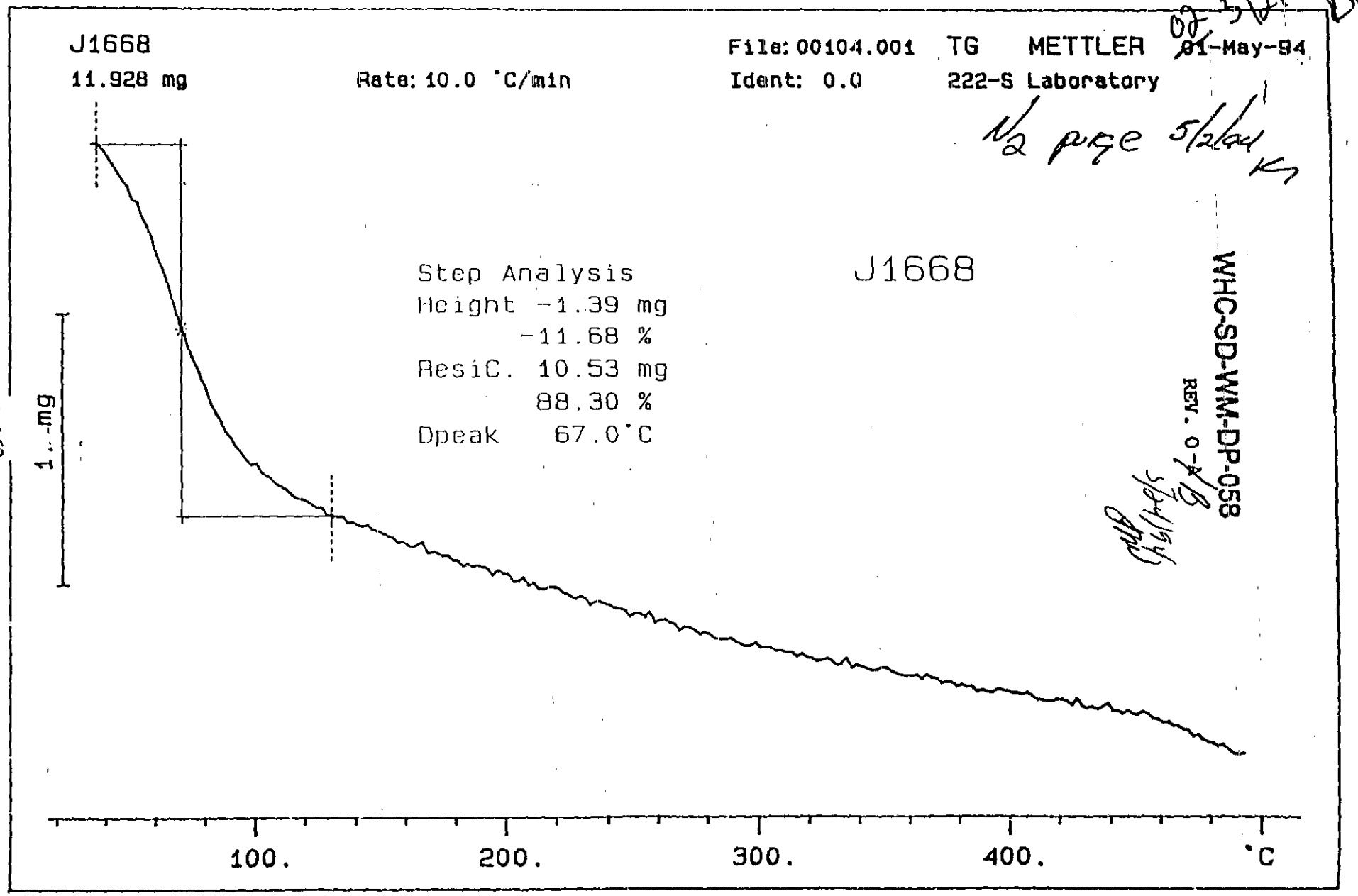
5/2/94

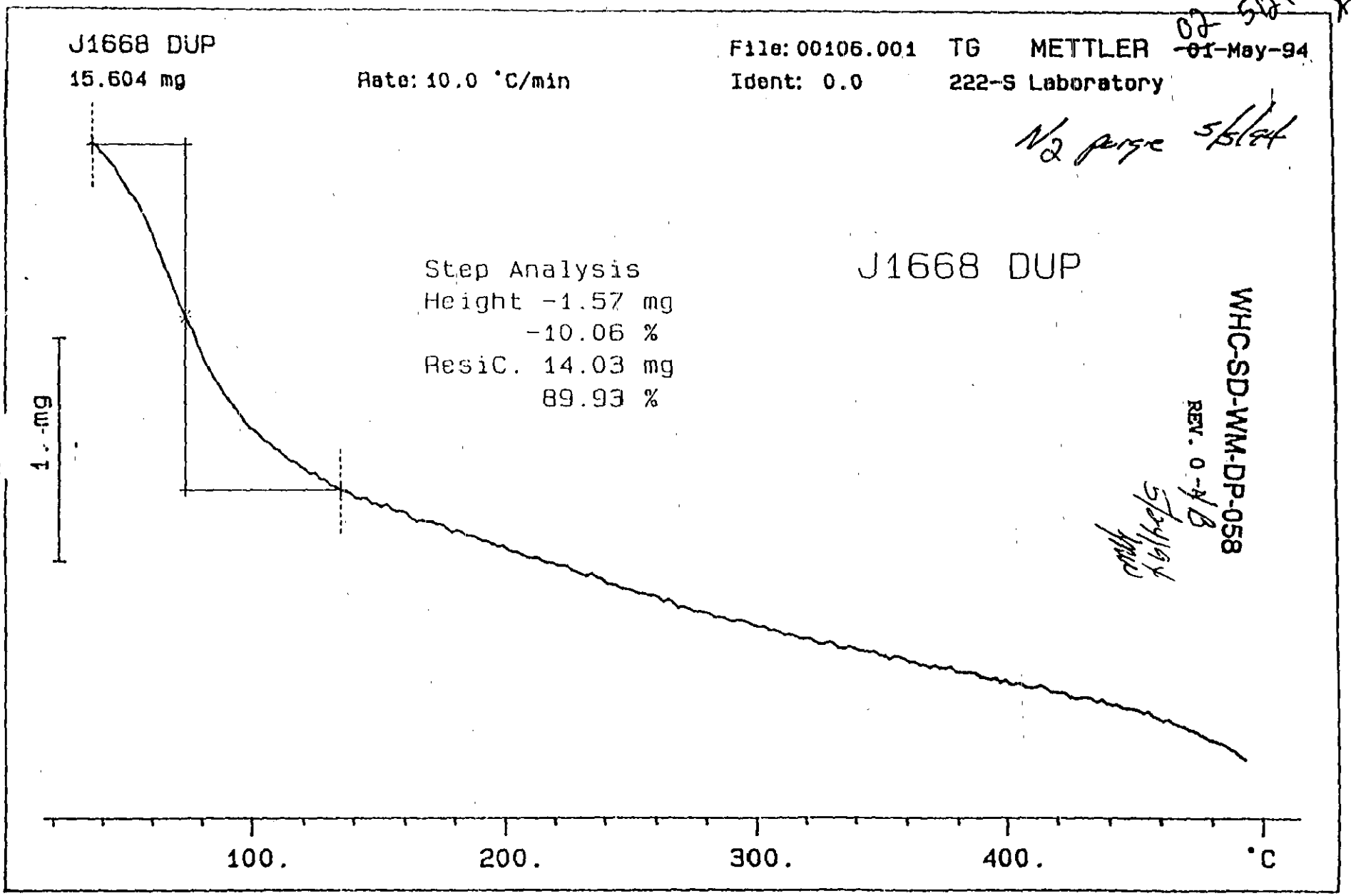


WHC-SD-WM-DP-058
REV. 0-A
Sept 94

A-161

WHC-EP-0806

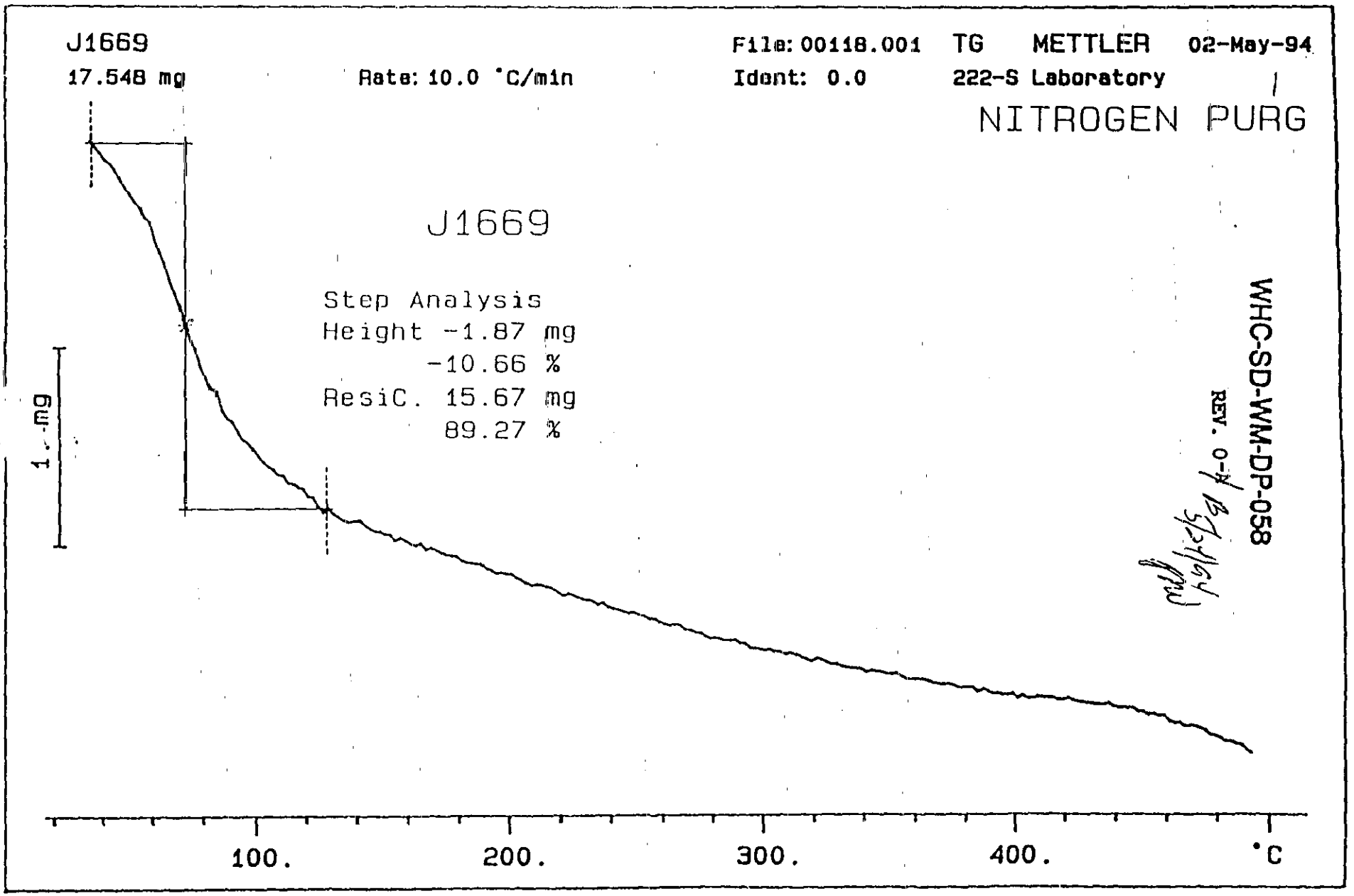

J1668
11.928 mg
Rate: 10.0 °C/min
File: 00104.001 TG METTLER 01-May-94
Ident: 0.0 222-S Laboratory
Step Analysis
Height -1.39 mg
-11.68 %
ResiC. 10.53 mg
88.30 %
Dpeak 67.0°C
J1668
1 mg
100.
200.
300.
400.
°C

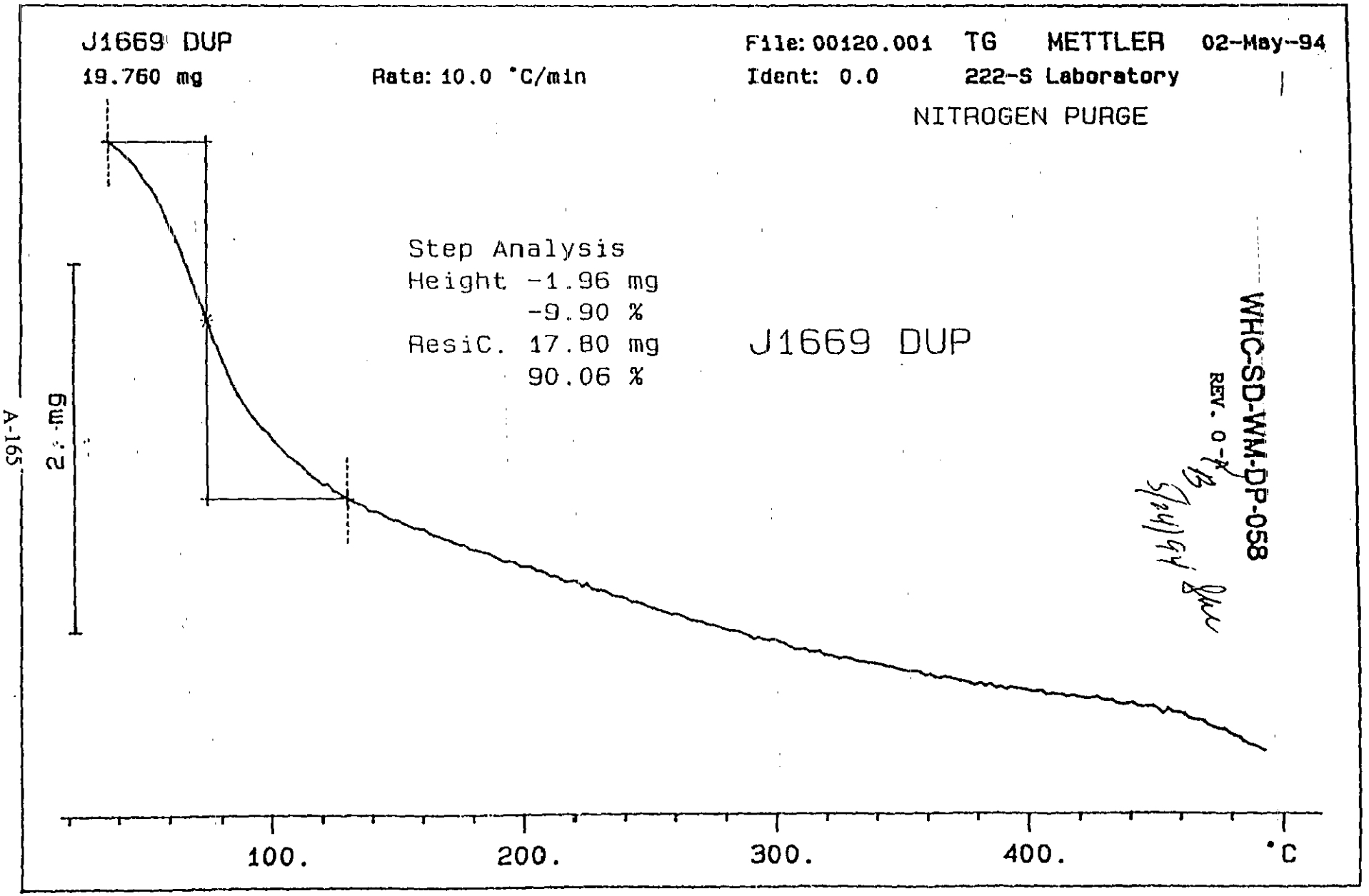


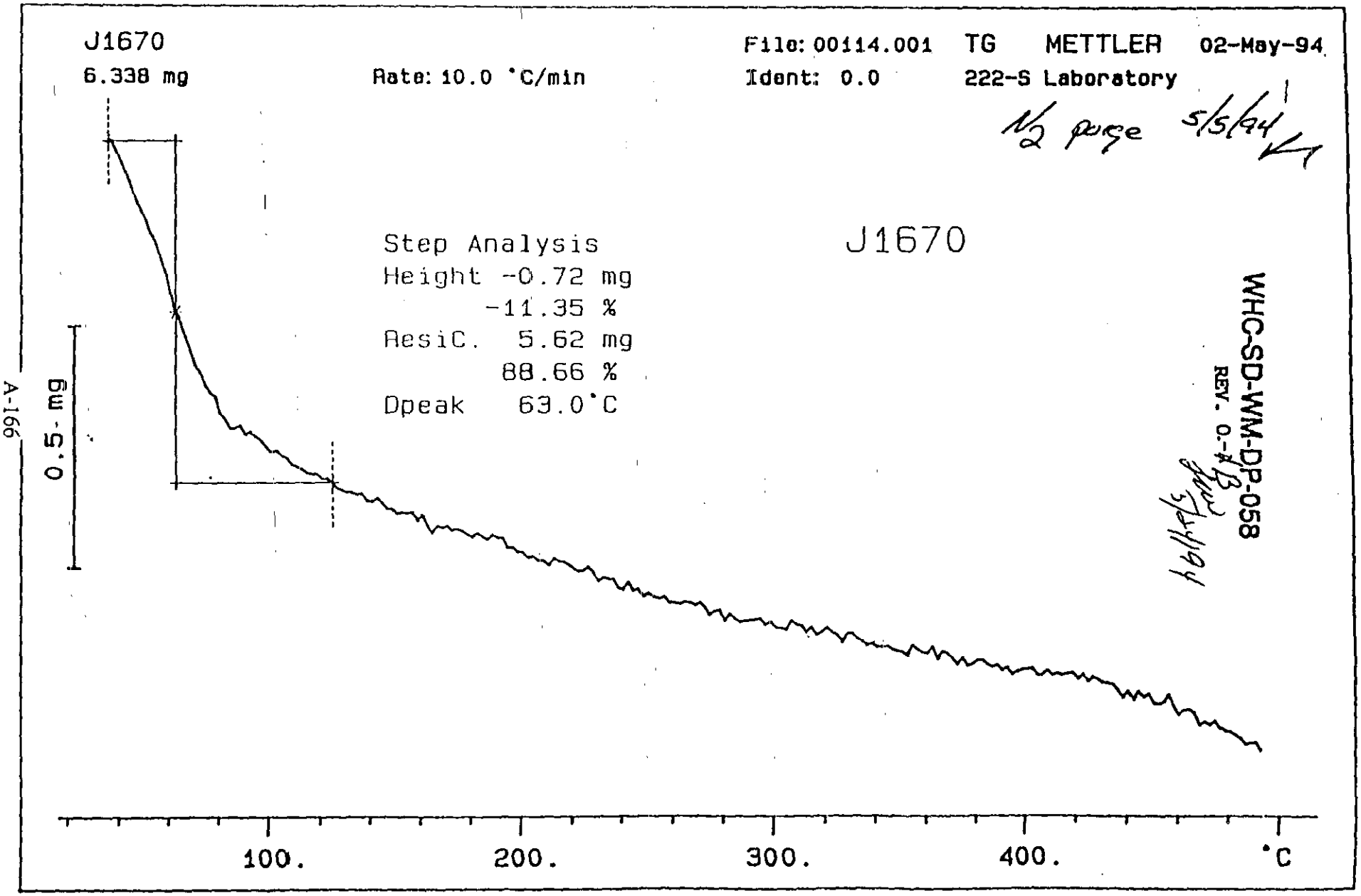
WHC-SD-WM-DP-058
REV. 0-A

WHC-EP-0806

A-163


J1669
17.548 mg
Rate: 10.0 °C/min
File: 00118.001
Ident: 0.0
TG METTLER 02-May-94
222-S Laboratory
NITROGEN PURG
J1669
Step Analysis
Height -1.87 mg
-10.66 %
ResiC. 15.67 mg
89.27 %
1 mg
100.
200.
300.
400.
°C


J1669 DUP
19.760 mg
Rate: 10.0 °C/min
File: 00120.001 TG METTLER 02-May-94
Ident: 0.0 222-S Laboratory
NITROGEN PURGE
Step Analysis
Height -1.96 mg
-9.90 %
ResiC. 17.80 mg
90.06 %
J1669 DUP
2 mg
100.
200.
300.
400.
°C


J1670
6.338 mg
Rate: 10.0 °C/min
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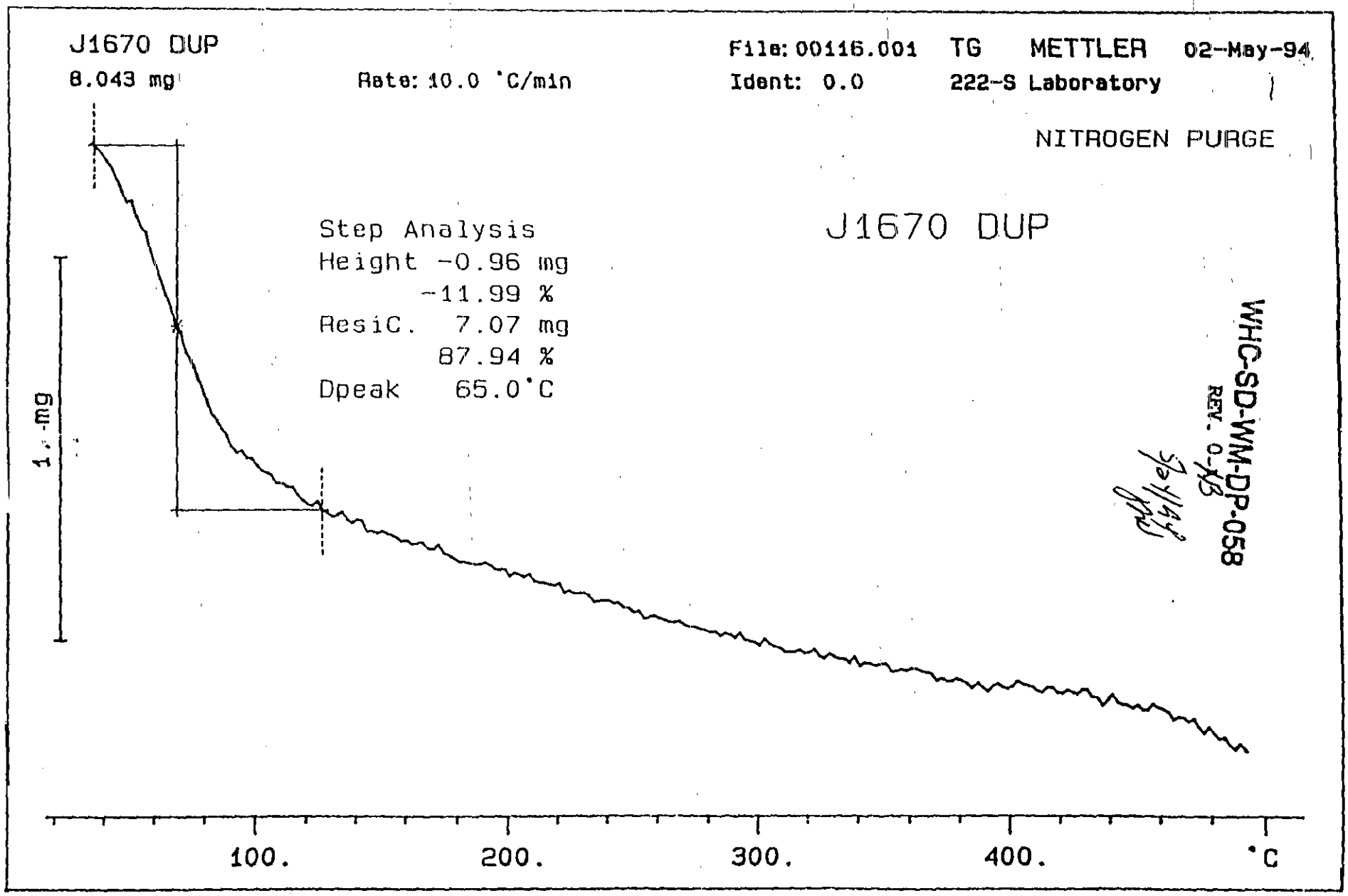
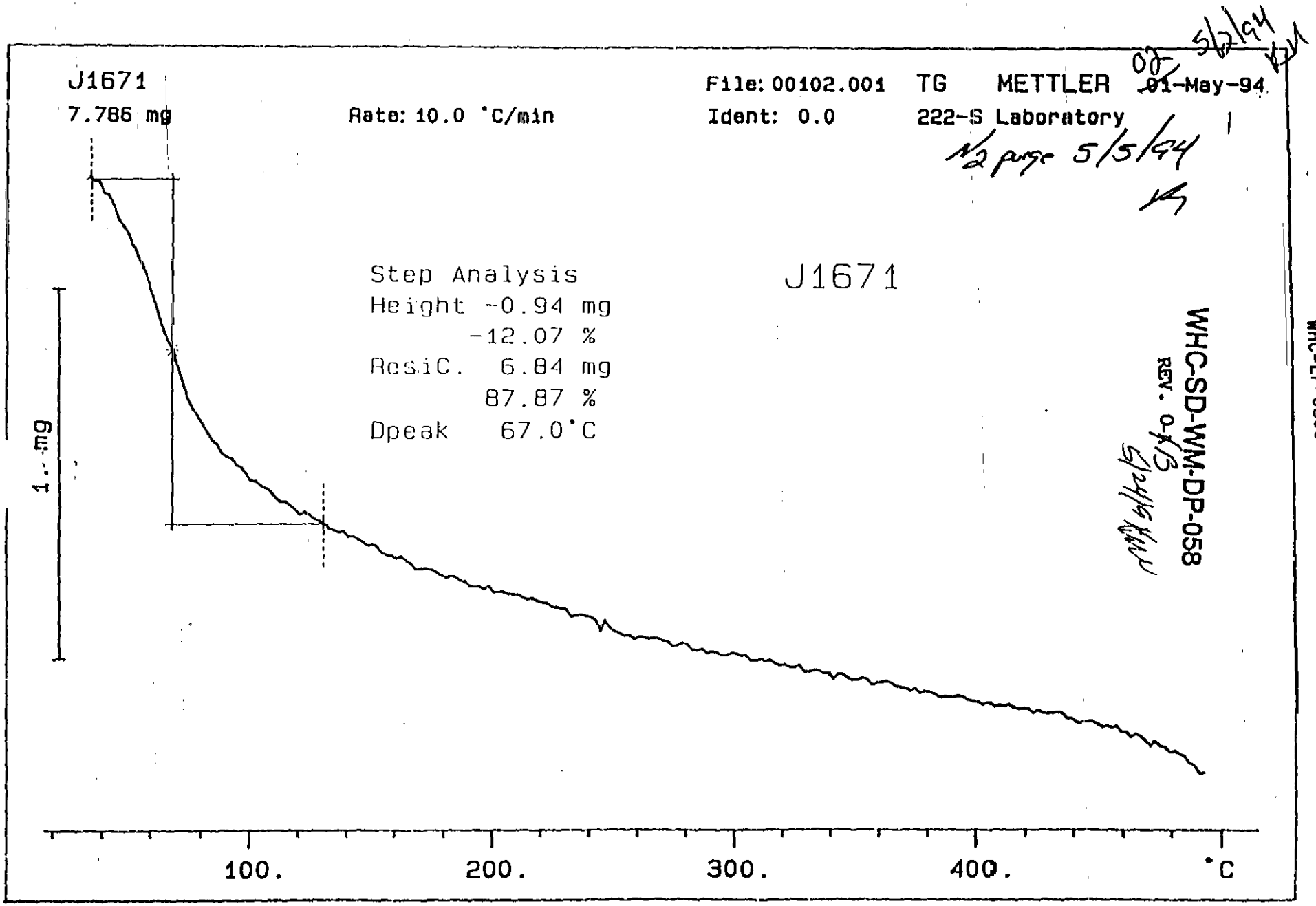
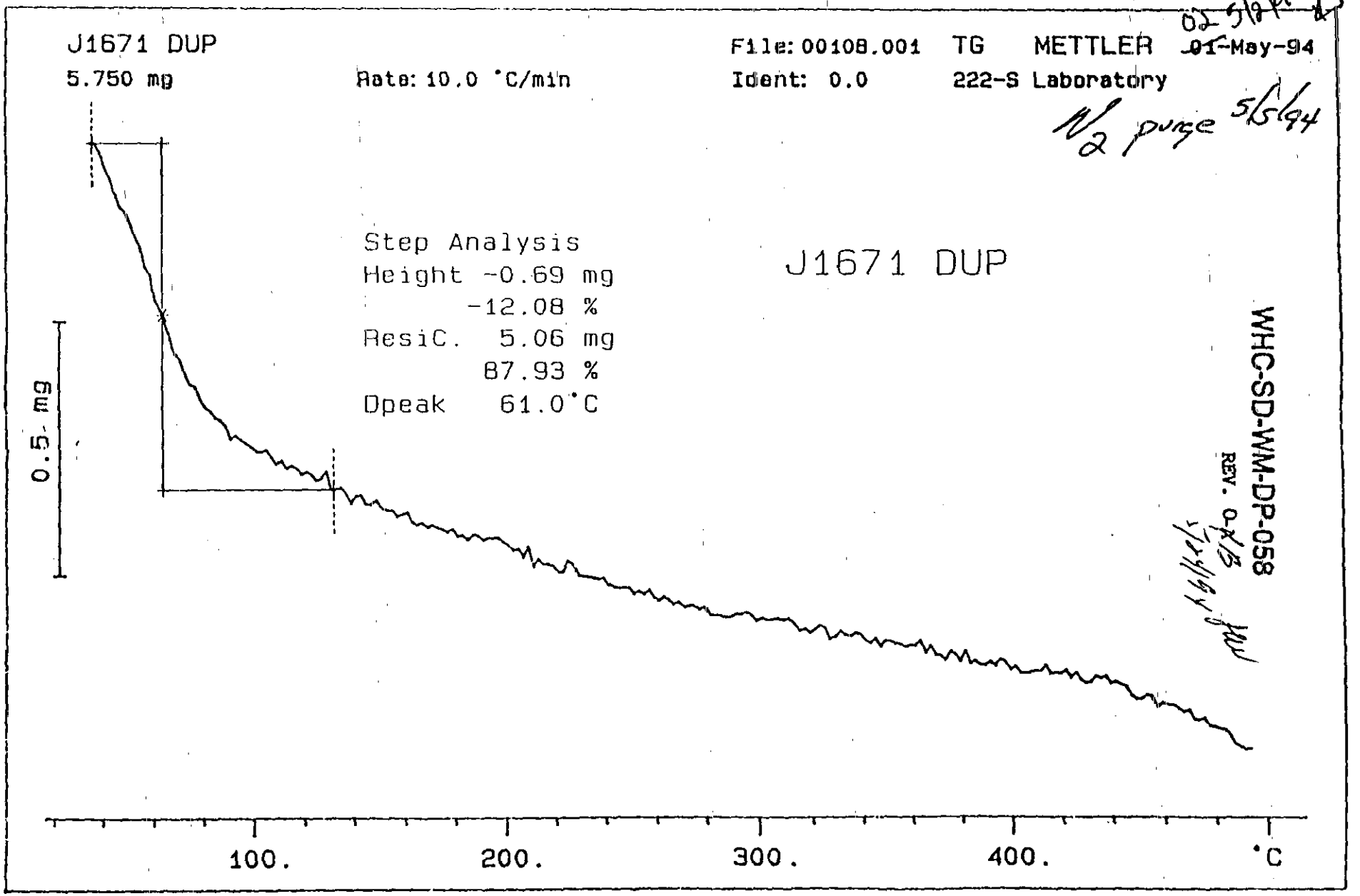
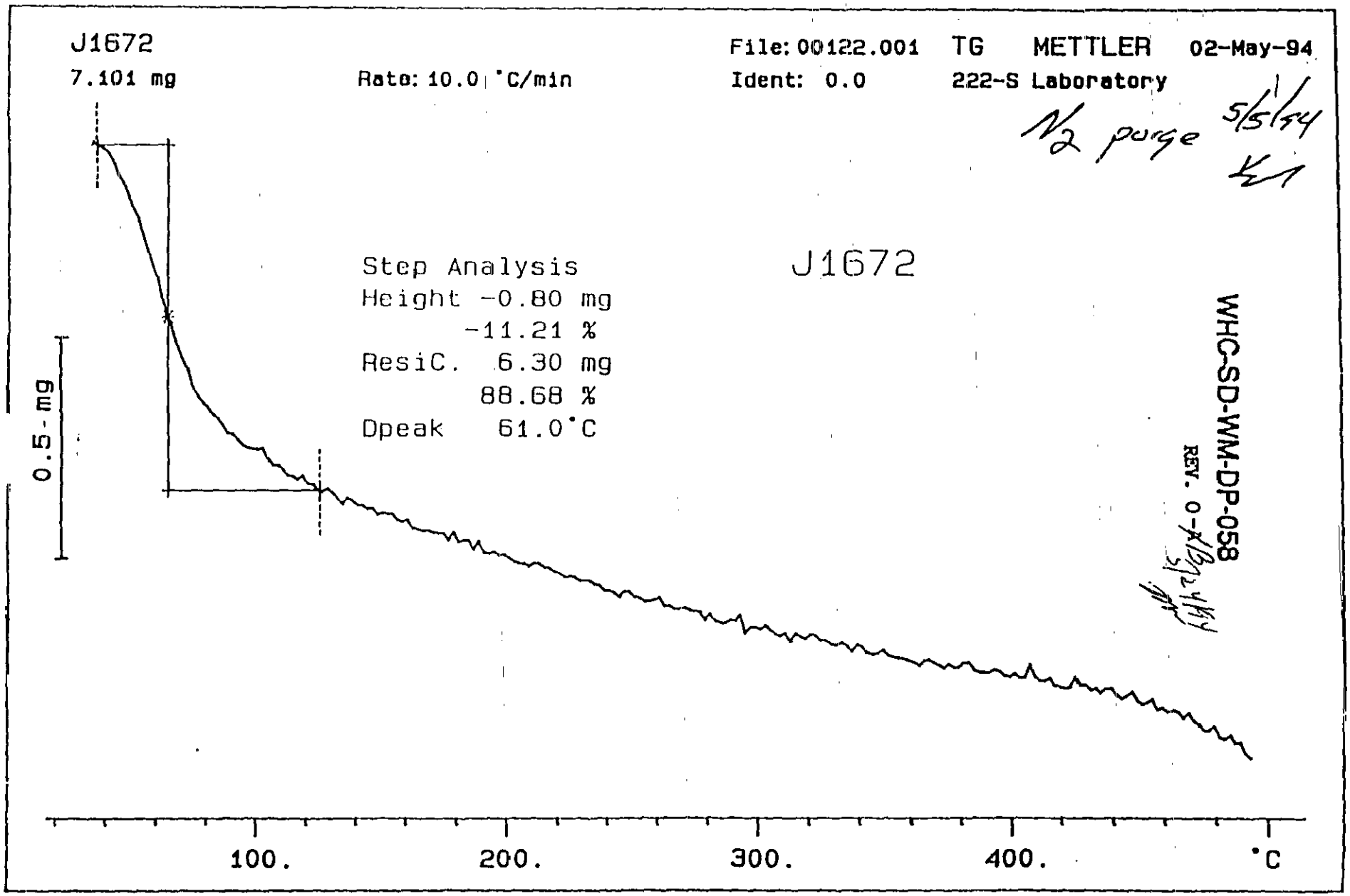
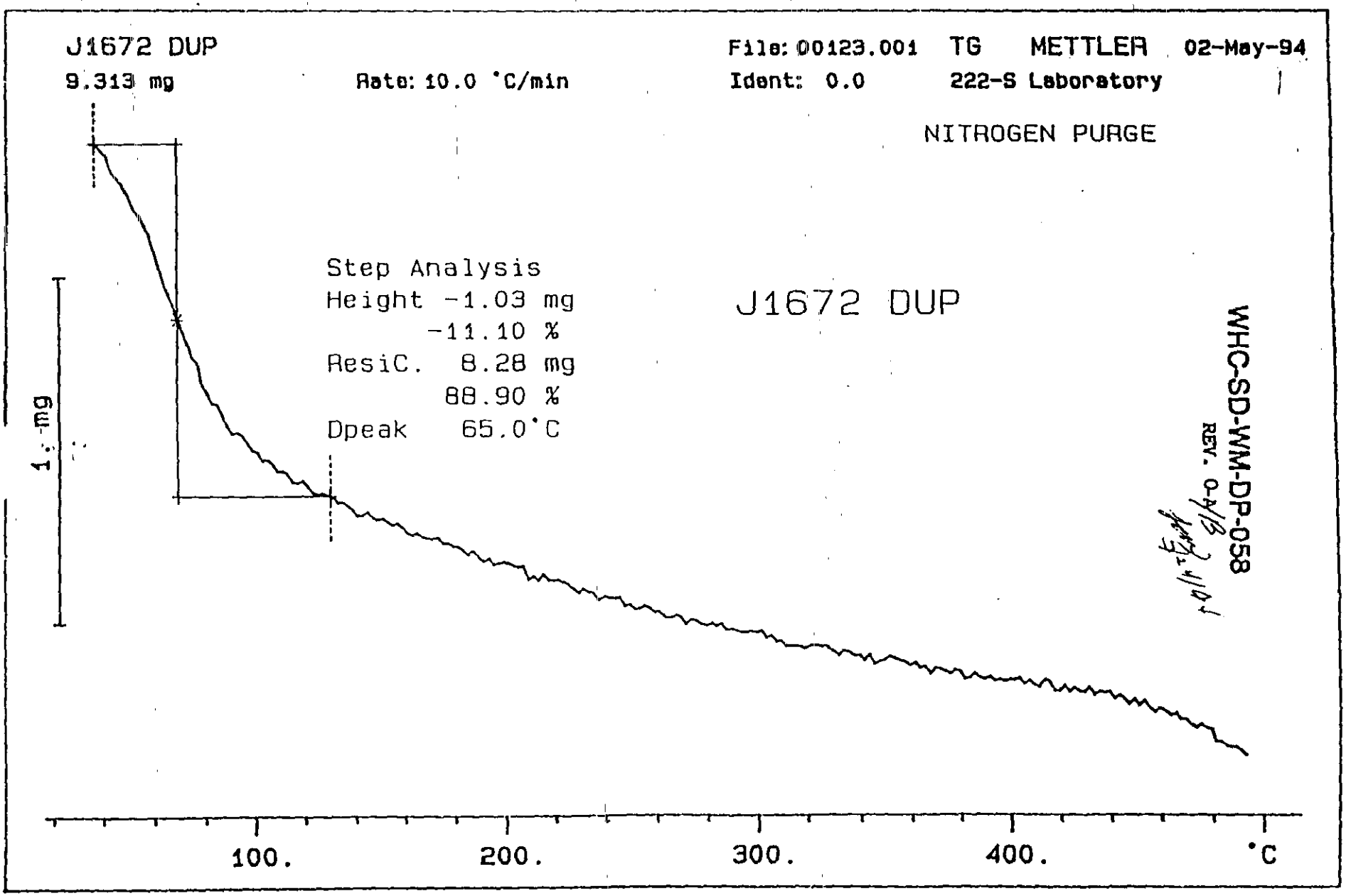
Ident: 0.0 222-S Laboratory
N2 purge 5/5/94
Step Analysis
Height -0.72 mg
-11.35 %
ResiC. 5.62 mg
88.66 %
Dpeak 63.0°C
J1670
δw -5.0 mg
100.
200.
300.
400.
°C




J1671
7.786 mg
Rate: 10.0 °C/min
File: 00102.001 TG METTLER 01-May-94
Ident: 0.0 222-S Laboratory
N2 purge 5/5/94
Step Analysis
Height -0.94 mg
-12.07 %
ResiC. 6.84 mg
87.87 %
Dpeak 67.0°C
J1671
1.. mg
100.
200.
300.
400.
°C
A-168
WHC-SD-WM-DP-058
REV. 0
WHC-EP-0806


J1671 DUP
5.750 mg
Rate: 10.0 °C/min
File: 00108.001 TG METTLER 01-May-94
Ident: 0.0 222-S Laboratory
N2 purge 5/5/94
Step Analysis
Height -0.69 mg
-12.08 %
ResiC. 5.06 mg
87.93 %
Dpeak 61.0°C
J1671 DUP
5.0 mg
100.
200.
300.
400.
°C


J1672
7.101 mg
Rate: 10.0 °C/min
File: 00122.001 TG METTLER 02-May-94
Ident: 0.0 222-S Laboratory
N2 purge 5/5/94
Step Analysis
Height -0.80 mg
-11.21 %
ResiC. 6.30 mg
88.68 %
Dpeak 61.0°C
J1672
0.5 mg
100.
200.
300.
400.
°C


J1672 DUP
9.313 mg
Rate: 10.0 °C/min
File: 00123.001 TG METTLER 02-May-94
Ident: 0.0 222-S Laboratory
NITROGEN PURGE
Step Analysis
Height -1.03 mg
-11.10 %
ResiC. 8.28 mg
88.90 %
Dpeak 65.0°C
J1672 DUP
1 mg
100.
200.
300.
400.
°C

Appendix B: Statistical Interpretation

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SUPPORTING DOCUMENT

1. Total Pages 61

2. Title	3. Number	4. Rev No.
Statistical Characterization Report for Single-Shell Tank 241-T-111	WHC-SD-WM-TI-650	0

5. Key Words

Single-Shell Tank, Waste, Characterization, Sampling, Sample Homogenization, Core Composite Samples

APPROVED FOR PUBLIC RELEASE

KMB 9/20/94

6. Author

Name: R. D. Cromar/S.R. Wilmarth

Signature

Name: Louis Jensen

Signature 9/20/94

Organization/Charge Code 8E100/N4D2G

7. Abstract

This report documents the statistical analyses performed on core data from Single-Shell Tank 241-T-111

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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 600493

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
Distribution	Process Laboratories & Technology	600490
5. Proj./Prog./Dept./Div.:	**6. Cog. Engr.:**	**7. Purchase Order No.:**
WM	L. Jensen	NA
8. Originator Remarks: Release of document "Statistical Characterization Report for Single-Shell Tank 241-T-111"		**9. Equip./Component No.:** NA
		10. System/Bldg./Facility: NA
11. Receiver Remarks:		**12. Major Assm. Dwg. No.:** NA
		13. Permit/Permit Application No.: NA
		14. Required Response Date: 9-30-94

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-TI-650		0	Statistical Characterization Report for Single-Shell Tank 241-T-111	NA	2	1	1

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 (see MRP 5.43)	1. Approval 4. Review 2. Release 5. Post-Review 3. Information 6. Dist. (Receipt Acknow. Required)	1. Approved 4. Reviewed no/comment 2. Approved w/comment 5. Reviewed w/comment 3. Disapproved w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
2	1	Cog.Eng. L. Jensen	L Jensen	9/20/94	T6-07						
2	1	Cog. Mgr. J. P. Sloughter		9-20-94	T6-07						

18.	19.	20.	21. DOE APPROVAL (if required)
L. Jensen Signature of EDT Originator — Date 9/20/94	Authorized Representative for Receiving Organization — Date	J. P. Sloughter Cognizant/Project Engineer's Manager — Date 9-20-94	Ltr. No. [] Approved [] Approved w/comments [] Disapproved w/comments

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LIST OF TERMS

222-S	Process and Analytical Laboratories
95% LL	lower limit of a 95% confidence interval on the mean
95% UL	upper limit of a 95% confidence interval on the mean
ANOVA	analysis of variance
T111	tank 241-T-111
CI	confidence interval
df	degrees of freedom
.dir	direct
DL	detection limit
GEA	gamma energy analysis
IC	ion chromatography
IC.w.	ion chromatography of a water leached sample
ICP	inductively coupled plasma analysis
ICP.a.	inductively coupled plasma analysis of an acid digested sample
ICP.f.	inductively coupled plasma analysis of a fusion digested sample
ICP.w.	inductively coupled plasma analysis of a water leached sample
.w.Spec	spectroscopic method of a water leached sample
KOH/Ni	Potassium Hydroxide/Nickel
Mean/DL	the mean of two sample results (sample and duplicate) divided by the detection limit
mL	milliliters
NA	not available
RAD.f.	radiochemistry analysis of a fusion digested sample
REML	restricted maximum likelihood estimation method
SST	single-shell tank
TGA	thermal gravimetric analysis
$\bar{y}$	weighted mean of the concentration data
$\hat{\sigma}^2(\bar{y})$	estimated variance of $\bar{y}$
µCi/L	microcuries per liter
µg/g	micrograms per gram
µCi/g	microcuries per gram

STATISTICAL CHARACTERIZATION REPORT FOR SINGLE-SHELL TANK 241-T-111

1.0 SUMMARY

This report contains the results of the statistical analysis of data from two core samples obtained from Single-Shell Tank 241-T-111 (T111).

Section 2 contains a description of the core samples and the chemical analyses done on the core samples.

Section 3 contains mean concentration estimates and associated 95% confidence intervals (CI) on the mean for each of the analytes in T111.

Section 4 contains estimates of the spatial variability (variability between cores) and estimates of the "analytical error" from the core composite data.

Two types of analytical error were estimated from the core composite data: (1) compositing variability (variability between composite samples within the same core) and (2) analytical measurement error (variability between the primary and duplicate analyses within each core composite sample). Estimates of the analytical measurement error were used as the reference value to test the significance of the spatial and compositing variability. Spatial variability was significantly different than zero[1] for 39 out of 85 analytes in T111. The compositing variance was significantly different than zero for 39 out of the 85 analytes.

[1] Significantly different than zero at the $\alpha = 0.05$ level.

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2.0 INTRODUCTION

Two core samples (cores 31 and 33) were taken from T111. Cores 31 and 33 were obtained form risers 6 and 3, respectively. Figure 2-1 (p. 2-2) gives the locations of the risers. The segment recoveries for each core are given in Table 2-1. Core 31 had nearly 100% segment recovery for all segments except segments 1 and 6. There was nearly 100% segment recovery for all of the segments in Core 33.

Table 2-1. T-111 Core Recoveries.

Core	Segment Number								
	1	2	3	4	5	6	7	8	9
31	27%	80-100%	95-100%	80-100%	100%	0%	90-100%	100%	100%
33	100%	100%	87-100%	75-85%	88%	100%	100%	100%	100%

Due to the incomplete core sample recovery, the concentration estimates given in this report are biased. The magnitude of the bias is unknown.

Two core composite samples were made for each core sample from the homogenized solid segment waste. Primary and duplicate results were obtained from each core composite sample.

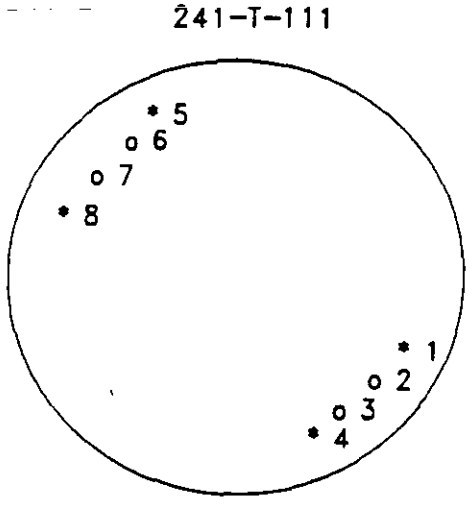
The chemical analysis of the primary and duplicate samples consisted of the following analytical methods and sample preparations (the notation for the method and preparation is also listed):

- inductively coupled plasma analysis (ICP) of an acid digested sample (ICP.a),
- ICP of a potassium hydroxide/nickel (KOH/Ni) fused sample, (ICP.f)
- ICP analysis of a water leached sample (ICP.w),
- ion chromatography (IC) of a water leached sample (IC.w),
- radio chemistry, and
- gamma energy analysis (GEA).

Occasionally, special analytical methods are used on prepared and unprepared waste samples. The notation for the results from such methods is given in the tables of Appendix A and the tables in Sections 3 and 4.

Whenever possible, the results and data given here are identified by the analysis method, the type of dissolution and analyte. For example, the notation ICP.a.Al refers to the Al concentration from an ICP analysis of an acid digested sample.

Figure 2-1. Riser location.



o 12" Riser
* 4" Riser

The core composite sample results are contained in Table A-1 (Appendix A). Ratios of the mean of each primary and duplicate result divided by the detection limit for that pair are also included. The ratios (Mean/DL) are provided to show how large the analyte concentrations are relative to the DL. The data packages for tank T111 (Kocher, 1993 and McKinney, 1993) contain a complete report of the sample results along with the laboratory quality control data. The core composite data for each analyte are illustrated in the figures provided in Appendix B.

Analysis of variance (ANOVA) models were fit to the data for all analytes that did not have any "less than values". All of the data available for statistical analysis, including the analytes with at least one "less than value," are reported in Table A-1. The ratios (Mean/DL) of all of the data are also reported in Table A-1.

From a quality of data perspective, it is desirable that the ANOVA models be applied to analyte concentrations greater than 10 times the detection limit. However, Analytical Evaluation and Reporting personnel, within the TWRS Information Management Systems, identified a list of "special analytes," given in Table 2-2. For this list, they requested that the ANOVA models be fit to the data provided the concentration values were greater than 3 times the detection limit or less than 10 times the detection limit.

Whenever possible the ANOVA models were fit using all of the data, regardless of the value of the detection limit. To warn the reader of potential detection limit problems the analytes in Tables 3-1, 4-1 and A-1 are denoted by a "•" or a "★" whenever a concentration is less than 3 times or 10 times the detection limit respectively. The results for such analytes are to be used with caution.

In Table A-1, some analytes are marked with a "*." Due to the dilution factors, the analytical result values are so close to the detection limit (DL), that the concentration values are questionable. For these analytes, ANOVA models were not fit to the data.

Table 2-2. Special Analyte List.

Aluminum	Nitrate
Bismuth	Nitrite
Calcium	Phosphate
Chromium	Carbonate
Iron	Fluoride
Silicon	Chloride
Sodium	Total Organic Carbon
Zirconium	Cyanide

A close examination of the figures in Appendix B reveals several "outlier data points" in the core composite data:

- ICP.a.Co The primary result for core 31, composite 2 of 11.7 μg/g is over three times as large as the duplicate result. The other results for ICP.a.Co all fall in the range 2.7 to 3.8 μg/g. The detection limit for ICP.a.Co is 0.8 μg/g.

- ICP.a.Cu The duplicate result for core 31, composite 2 of 127 μg/g is about four times as large as the primary result of 31.7 μg/g. The detection limit for ICP.a.Cu is 0.4 μg/g.
- NO_2 Both the primary and duplicate results from core 31, composite 2 are about one half the results for core 31, composite 1. The average of the results for core 31, composite 1, is 952 μg/g, the average for composite two is 525 μg/g. The detection limit for NO_2 (by water digestion spectrophometric analysis) is 50 μg/g.

There is no direct evidence that the results noted above are due to analytical measurement errors. Consequently, the statistical analysis was performed on the data as it is reported in Table A-1. The potential anomalies in the data noted above can be clearly seen in the figures in Appendix B.

3.0 MEAN CONCENTRATION ESTIMATES

One of the tasks outlined in the Tank Waste Characterization Plan, Section 5.1.1.2 (Bell, 1993), is to estimate the constituent inventories in the waste. The inventories are estimated by computing mean concentrations and 95% confidence intervals (CIs) on the mean concentrations for each constituent. The estimate of the inventory and CI on the inventory of an analyte in the tank are equal to the corresponding mean concentration estimates and CI multiplied by the volume of waste in the tank. Therefore, estimates of tank inventory are not given in this document.

Table A-1 (Appendix A) contains the core composite data used to compute the mean concentration estimates and associated CIs.

3.1 STATISTICAL METHODS

The concentration estimates are given in the form of 95% CIs on the mean concentration. It is assumed that each primary sample and its duplicate are analyzed independently of one another. The two analytical results are used to estimate the analytical measurement error. Due to the hierarchical structure of the data, the analytical measurement error alone is not the appropriate error term to use in computing the CIs. A linear combination of the analytical measurement variance and the spatial variance is the appropriate variance of the mean for the CIs (Snedecor and Cochran, 1980). Appendix C contains a description of the statistical model and formulas used to calculate estimates of the mean, variance of the mean and the CI on the mean.

3.2 STATISTICAL RESULTS

Table 3-1 contains the summary statistics, by analyte, for ICP acid digestion, ICP water leach, ICP KOH/Ni fusion dissolution, radio chemistry and IC analyses. The summary statistics are defined as follows:

$\bar{y}$	mean of the concentration data,
$\hat{\sigma}^2(\bar{y})$	estimated variance of $\bar{y}$,
df	degrees of freedom,
95% LL	lower limit to the 95% CI on the mean and
95% UL	upper limit to the 95% CI on the mean.

For some analytes the lower confidence limit (95% LL) was negative. Since concentrations are greater than or equal to zero, any negative 95% LL values were set equal to zero.

The confidence intervals in Table 3-1 are wide relative to the range of the data because only two cores were used to estimate the spatial variability. Two core samples is the minimum number of core samples needed to estimate a tank's spatial variability.

Table 3-1. Concentration Estimate Statistics (Units μg/g Except Radionuclides μCi/g). (sheet 1 of 3)

Analyte	$\bar{y}$	$\delta^2(\bar{y})$	df	95% LL	95% UL
ICP.a.Ag	1.26E+02	7.86E+03	1	0.00	1.25E+03
ICP.a.Al	5.41E+02	1.06E+04	1	0.00	1.85E+03
ICP.a.B	2.80E+01	7.56E+00	1	0.00	6.30E+01
ICP.a.Ba	6.90E+01	6.46E+01	1	0.00	1.71E+02
ICP.a.Bi	2.59E+04	6.38E+06	1	0.00	5.80E+04
ICP.a.Ca	1.88E+03	2.12E+05	1	0.00	7.72E+03
ICP.a.Cd*	5.80E+00	3.03E+00	1	0.00	2.79E+01
ICP.a.Ce*	3.37E+01	9.69E+00	1	0.00	7.33E+01
ICP.a.Co*	4.30E+00	1.63E+00	1	0.00	2.05E+01
ICP.a.Cr	1.98E+03	1.63E+04	1	3.57E+02	3.60E+03
ICP.a.Cu	3.35E+01	3.53E+02	1	0.00	2.72E+02
ICP.a.Fe	1.85E+04	1.21E+06	1	4.55E+03	3.25E+04
ICP.a.K	1.14E+03	2.24E+03	1	5.34E+02	1.74E+03
ICP.a.La	4.22E+03	3.00E+05	1	0.00	1.12E+04
ICP.a.Mg	3.77E+02	6.36E+03	1	0.00	1.39E+03
ICP.a.Mn	6.33E+03	2.68E+04	1	4.25E+03	8.41E+03
ICP.a.Na	3.69E+04	1.56E+06	1	2.10E+04	5.27E+04
ICP.a.Ni	1.32E+02	5.12E+02	1	0.00	4.19E+02
ICP.a.P	1.03E+04	1.21E+05	1	5.90E+03	1.47E+04
ICP.a.Pb	3.47E+02	2.64E+04	1	0.00	2.41E+03
ICP.a.S	1.21E+03	1.06E+03	1	8.00E+02	1.63E+03
ICP.a.Sb*	3.14E+01	1.65E+01	1	0.00	8.30E+01
ICP.a.Si	4.69E+02	9.17E+02	1	8.40E+01	8.54E+02
ICP.a.Sr	3.00E+02	3.75E+02	1	5.39E+01	5.46E+02
ICP.a.Ti	1.95E+01	1.39E+02	1	0.00	1.69E+02
ICP.a.V	1.45E+01	6.58E+00	1	0.00	4.71E+01
ICP.a.Zn	6.50E+01	6.46E+02	1	0.00	3.88E+02
ICP.f.Ag	1.28E+02	8.05E+03	1	0.00	1.27E+03
ICP.f.Al	5.70E+02	9.70E+03	1	0.00	1.82E+03
ICP.f.Ba	6.46E+01	2.45E+01	1	1.73E+00	1.28E+02
ICP.f.Bi	2.36E+04	9.08E+06	1	0.00	6.18E+04
ICP.f.Ca*	2.42E+03	8.27E+04	1	0.00	6.07E+03
ICP.f.Cd*	8.12E+00	1.76E+00	1	0.00	2.50E+01
ICP.f.Co*	1.15E+01	1.16E+00	1	0.00	2.52E+01
ICP.f.Cr	1.80E+03	1.56E+03	1	1.30E+03	2.30E+03

*: Analytes with a portion of the data below 3 times the DL.
*: Analytes with a portion of the data below 10 times the DL.

Table 3-1. Concentration Estimate Statistics (Units μg/g Except Radionuclides μCi/g). (sheet 2 of 3)

Analyte	$\hat{\varphi}$	$\hat{\sigma}^2(\hat{\varphi})$	df	95% LL	95% UL
ICP.f.Cu*	2.39E+01	3.56E+01	1	0.00	1.05E+02
ICP.f.Fe	1.80E+04	4.05E+06	1	0.00	4.36E+04
ICP.f.La	4.11E+03	3.08E+05	1	0.00	1.12E+04
ICP.f.Mg	3.55E+02	7.31E+03	1	0.00	1.44E+03
ICP.f.Mn	6.28E+03	1.88E+04	1	4.54E+03	8.02E+03
ICP.f.Na	3.70E+04	6.00E+06	1	5.82E+03	6.81E+04
ICP.f.Ni	8.14E+03	6.41E+06	1	0.00	4.03E+04
ICP.f.P	1.04E+04	8.42E+05	1	0.00	2.21E+04
ICP.f.Pb*	3.65E+02	9.38E+03	1	0.00	1.60E+03
ICP.f.S	1.23E+03	1.13E+04	1	0.00	2.58E+03
ICP.f.Si	5.67E+03	5.41E+04	1	2.71E+03	8.62E+03
ICP.f.Sr	2.98E+02	6.24E+01	1	1.97E+02	3.98E+02
ICP.f.Ti	4.79E+01	6.09E+02	1	0.00	3.62E+02
ICP.f.V*	1.47E+01	8.32E-01	1	3.06E+00	2.62E+01
ICP.f.Zn*	1.06E+02	7.17E+00	1	7.22E+01	1.40E+02
ICP.w.Al*	1.09E+01	5.75E+00	1	0.00	4.14E+01
ICP.w.B*	4.07E+00	6.77E-01	1	0.00	1.45E+01
ICP.w.Bi	2.02E+02	2.40E+03	1	0.00	8.24E+02
ICP.w.Ca*	6.16E+01	3.32E+01	1	0.00	1.35E+02
ICP.w.Cr	2.18E+02	2.45E+01	1	1.55E+02	2.81E+02
ICP.w.Fe	1.28E+02	3.11E+02	1	0.00	3.52E+02
ICP.w.K	7.19E+02	1.54E+03	1	2.21E+02	1.22E+03
ICP.w.La*	1.10E+01	1.42E+01	1	0.00	5.89E+01
ICP.w.Mg*	3.64E+00	5.45E-02	1	6.75E-01	6.61E+00
ICP.w.Mn	2.47E+01	2.36E+01	1	0.00	8.65E+01
ICP.w.Na	3.30E+04	2.44E+06	1	1.31E+04	5.28E+04
ICP.w.P	5.68E+03	3.24E+04	1	3.39E+03	7.97E+03
ICP.w.S	1.15E+03	2.38E+03	1	5.29E+02	1.77E+03
ICP.w.Si	5.72E+02	5.35E+03	1	0.00	1.50E+03
ICP.w.Sr*	1.96E+00	8.65E-02	1	0.00	5.70E+00
IC.w.Cl	4.50E+02	1.11E+03	1	2.56E+01	8.74E+02
IC.w.F	2.30E+03	6.46E+05	1	0.00	1.25E+04
IC.w.NO3	4.12E+04	7.77E+06	1	5.82E+03	7.67E+04
IC.w.PO4	1.55E+04	1.53E+06	1	0.00	3.13E+04
IC.w.SO4	3.54E+03	2.85E+04	1	1.40E+03	5.69E+03

*: Analytes with a portion of the data below 3 times the DL.
*: Analytes with a portion of the data below 10 times the DL.

Table 3-1. Concentration Estimate Statistics (Units μg/g Except Radionuclides μCi/g). (sheet 3 of 3)

Analyte	$\bar{y}$	$s^2(\bar{y})$	df	95% LL	95% UL
GEA.Am-241	4.24E-02	2.61E-06	1	2.19E-02	6.29E-02
GEA.Cs-137	1.66E-01	3.35E-03	1	0.00	9.02E-01
Gross.alpha	3.73E-01	1.96E-04	1	1.95E-01	5.51E-01
Gross.beta	1.51E+01	3.48E+01	1	0.00	9.00E+01
TGA.%.H2O	7.65E+01	2.23E+01	1	1.64E+01	1.37E+02
Am-241*	4.26E-02	6.65E-25	1	4.26E-02	4.26E-02
Hg*	1.43E+00	1.53E-01	1	0.00	6.40E+00
NO2.W.Spec	7.93E+02	8.76E+03	1	0.00	1.98E+03
Percent.H2O	7.60E+01	5.81E-01	1	6.63E+01	8.57E+01
Pu-239/40	1.39E-01	9.19E-06	1	1.00E-01	1.77E-01
Sr-90	5.41E+00	3.53E+00	1	0.00	2.93E+01
TOC*	3.12E+03	3.83E+05	1	0.00	1.10E+04
Tc-99•	7.92E-03	8.90E-06	1	0.00	4.58E-02
U*	2.79E+03	2.01E+05	1	0.00	8.50E+03
pH	9.98E+00	7.79E-03	1	8.86E+00	1.11E+01

•: Analytes with a portion of the data below 3 times the DL.
*: Analytes with a portion of the data below 10 times the DL.

4.0 COMPARISON OF THE VARIANCE COMPONENT ESTIMATES

Using the hierarchical structure of the core composite data, estimates of the between core spatial variability ($\sigma^2(S)$), the compositing variability ($\sigma^2(C)$) and the analytical measurement variability ($\sigma^2(A)$) can be obtained. The spatial variance is a measure of the variability between cores. The compositing variance measures the variability between composite samples within the same core. The analytical measurement variance includes, among other things, the sample handling error and the chemical analysis error. This variance is a measure of the difference between the analytical results from the primary and duplicate samples.

The estimate of the variance of the mean is a linear function of the spatial, compositing and analytical measurement variances. To help evaluate the magnitude of these three variance components, estimates of each variance component are given in Table 4-1.

4.1 STATISTICAL METHODS

Estimates of the spatial variance ($\hat{\sigma}^2(S)$), compositing variance ($\hat{\sigma}^2(C)$) and analytical measurement variance ($\hat{\sigma}^2(A)$), were obtained for each analyte using Restricted Maximum Likelihood Estimation (REML) methods. Restricted maximum likelihood estimation is discussed by Harville (1977).

To test the significance of the variance components, an analysis of variance (ANOVA) was calculated using the hierarchical statistical model described in Appendix C. The mean square error terms in the ANOVA tables were used to perform F-tests on the spatial variability and F-tests on the composite variability. These tests determine whether or not $\sigma^2(S)$ and $\sigma^2(C)$ are significantly different than zero. The p-values given in Table 4-1 were derived from the results of these tests.

4.2 STATISTICAL RESULTS

The REML estimates of each component of variability along with the p-values (significance level) from the F-tests are given in Table 4-1. A p-value less than 0.05 indicates that $\sigma^2(S)$ or $\sigma^2(C)$ is significantly different than zero at the 0.05 level.

The p-values from the tests on $\sigma^2(S)$ were less than 0.05 for 39 out of the 85 analytes in T111. This indicates that the differences between the two cores were statistically significant for these 39 cases.

The p-values from the tests on $\sigma^2(C)$ were less than 0.05 for 39 out of the 85 analytes in T111. This indicates that, relative to the analytical error, differences between composite samples were significantly different than zero in 39 cases. This means, for these 39 analytes, the two composite samples were statistically different from each other. Conversely, for 46 out of 85 cases, differences between composite samples were not statistically significant.

Table 4-1. Variance Component Estimates. (sheet 1 of 3)

Analyte	$\sigma^2(S)$	Test: $\sigma^2(S)=0$ p-value	$\sigma^2(C)$	Test: $\sigma^2(C)=0$ p-value	$\sigma^2(A)$
ICP.a.Ag	1.56E+04	0.001	1.94E+02	0.000	3.16E+00
ICP.a.Al	1.89E+04	0.055	4.79E+03	0.000	1.06E+01
ICP.a.B	1.25E+01	0.093	9.28E-01	0.387	8.59E+00
ICP.a.Ba	6.91E+01	0.263	1.20E+02	0.000	3.54E-01
ICP.a.Bi	1.27E+07	0.000	6.25E+03	0.360	3.75E+04
ICP.a.Ca	4.10E+05	0.010	2.17E+04	0.074	9.95E+03
ICP.a.Cd*	5.96E+00	0.004	1.90E-01	0.039	5.34E-02
ICP.a.Ce*	1.69E+01	0.064	9.66E-01	0.380	7.87E+00
ICP.a.Co*	8.92E-01	0.376	8.08E-01	0.389	7.84E+00
ICP.a.Cr	3.17E+04	0.007	1.36E+03	0.081	6.75E+02
ICP.a.Cu	3.39E+02	0.290	1.67E+02	0.369	1.14E+03
ICP.a.Fe	2.33E+06	0.013	1.55E+05	0.063	6.25E+04
ICP.a.K	2.45E-24	0.911	8.86E+03	0.000	1.75E+02
ICP.a.La	5.91E+05	0.003	1.63E+04	0.019	2.88E+03
ICP.a.Mg	1.25E+04	0.005	5.18E+02	0.001	1.58E+01
ICP.a.Mn	2.97E+04	0.254	4.29E+04	0.030	1.00E+04
ICP.a.Na	2.76E+06	0.057	6.73E+05	0.016	1.05E+05
ICP.a.Ni	1.02E+03	0.000	6.13E+00	0.091	3.38E+00
ICP.a.P	2.37E-22	0.608	4.77E+05	0.000	1.25E+04
ICP.a.Pb	5.20E+04	0.003	1.41E+03	0.000	1.91E+01
ICP.a.S	1.11E+03	0.268	1.94E+03	0.003	1.25E+02
ICP.a.Sb*	1.11E-20	0.739	1.44E-14	0.578	1.32E+02
ICP.a.Si	2.57E-31	0.946	7.61E-14	0.418	7.34E+03
ICP.a.Sr	6.38E+02	0.079	2.18E+02	0.004	1.54E+01
ICP.a.Ti	2.75E+02	0.001	4.69E+00	0.000	7.83E-02
ICP.a.V	1.83E+00	0.423	2.25E+01	0.000	2.30E-01
ICP.a.Zn	1.22E+03	0.021	1.35E+02	0.008	1.42E+01
ICP.f.Ag	1.61E+04	0.000	6.23E+00	0.295	1.83E+01
ICP.f.Al	1.90E+04	0.005	6.78E+02	0.030	1.57E+02
ICP.f.Ba	3.99E+01	0.102	1.71E+01	0.012	2.19E+00
ICP.f.Bi	1.81E+07	0.001	2.88E+04	0.392	2.94E+05
ICP.f.Ca*	1.51E+05	0.008	2.07E-19	0.804	5.86E+04
ICP.f.Cd*	2.17E+00	0.126	1.21E-20	0.649	5.38E+00
ICP.f.Co*	1.44E+00	0.078	1.01E-29	0.755	3.48E+00
ICP.f.Cr	3.72E-15	0.994	5.63E+03	0.013	1.21E+03

*: Analytes with a portion of the data below 3 times the DL.
*: Analytes with a portion of the data below 10 times the DL.

Table 4-1. Variance Component Estimates. (sheet 2 of 3)

Analyte	$\sigma^2_{(S)}$	Test: $\sigma^2_{(S)}=0$ p-value	$\sigma^2_{(C)}$	Test: $\sigma^2_{(C)}=0$ p-value	$\sigma^2_{(A)}$
ICP.f.Cu*	6.97E+01	0.005	2.00E+00	0.119	1.43E+00
ICP.f.Fe	8.00E+06	0.003	1.68E+05	0.079	8.13E+04
ICP.f.La	5.96E+05	0.010	3.82E+04	0.012	4.98E+03
ICP.f.Mg	1.46E+04	0.000	5.15E-44	0.913	1.60E+02
ICP.f.Mn	1.66E-11	0.553	7.02E+04	0.011	9.70E+03
ICP.f.Na	1.17E+07	0.007	5.43E+05	0.044	1.65E+05
ICP.f.Ni	1.17E+07	0.033	4.18E-12	0.498	4.39E+06
ICP.f.P	1.57E+06	0.028	1.95E+05	0.049	6.45E+04
ICP.f.Pb*	1.85E+04	0.003	4.35E+02	0.030	1.02E+02
ICP.f.S	2.15E+04	0.017	2.00E+03	0.008	2.13E+02
ICP.f.Si	1.06E+05	0.005	1.00E+03	0.369	6.83E+03
ICP.f.Sr	6.12E-16	0.661	1.15E+02	0.222	2.69E+02
ICP.f.Ti	1.22E+03	0.000	2.66E-01	0.331	1.12E+00
ICP.f.V*	5.86E-19	0.905	2.17E+00	0.107	2.31E+00
ICP.f.Zn*	5.69E-23	0.440	1.10E-22	0.839	5.74E+01
ICP.w.Al*	7.35E+00	0.208	6.93E+00	0.061	2.72E+00
ICP.w.B*	1.14E+00	0.082	3.99E-01	0.008	3.99E-02
ICP.w.Bi	3.90E+03	0.102	1.30E+03	0.123	9.66E+02
ICP.w.Ca*	1.86E-11	0.144	1.69E-22	0.862	2.66E+02
ICP.w.Cr	5.66E-20	0.979	9.52E+01	0.001	5.62E+00
ICP.w.Fe	6.16E+01	0.436	9.05E+02	0.077	4.29E+02
ICP.w.K	2.28E+03	0.148	1.57E+03	0.001	4.73E+01
ICP.w.La*	2.71E+01	0.015	1.34E+00	0.226	2.23E+00
ICP.w.Mg*	3.04E-21	0.597	1.61E-01	0.098	1.14E-01
ICP.w.Mn	2.51E+01	0.266	3.19E+01	0.130	2.51E+01
ICP.w.Na	4.53E+06	0.030	6.84E+05	0.002	2.88E+04
ICP.w.P	3.98E+04	0.222	3.94E+04	0.089	2.13E+04
ICP.w.S	3.95E+03	0.091	1.50E+03	0.014	2.13E+02
ICP.w.Si	8.53E+03	0.113	1.98E+03	0.272	4.72E+03
ICP.w.Sr*	6.35E-02	0.340	1.83E-01	0.061	7.19E-02
IC.w.Cl	1.99E+03	0.043	1.15E-10	0.509	9.66E+02
IC.w.F	1.28E+06	0.001	1.37E+04	0.102	8.44E+03
IC.w.NO3	1.42E+07	0.038	2.46E+06	0.013	3.44E+05
IC.w.PO4	2.59E+06	0.082	8.54E+05	0.030	1.99E+05

*: Analytes with a portion of the data below 3 times the DL.
*: Analytes with a portion of the data below 10 times the DL.

Table 4-1. Variance Component Estimates. (sheet 3 of 3)

Analyte	$\sigma^2_{(S)}$	Test: $\sigma^2_{(S)}=0$ p-value	$\sigma^2_{(C)}$	Test: $\sigma^2_{(C)}=0$ p-value	$\sigma^2_{(A)}$
IC.W.SO4	5.27E+04	0.032	7.04E+03	0.071	3.14E+03
GEA.Am-241	2.99E-32	0.786	8.13E-06	0.062	4.59E-06
GEA.Cs-137	6.61E-03	0.003	1.87E-04	0.000	1.88E-06
Gross.alpha	3.42E-04	0.065	7.74E-05	0.098	4.58E-05
Gross.beta	6.93E+01	0.000	3.14E-01	0.026	6.62E-02
TGA.%.H20	3.17E+01	0.008	3.78E-33	0.935	5.18E+01
Am-241*	6.65E-25	0.976	7.41E-06	0.173	1.66E-05
Hg*	1.53E-01	0.022	1.36E-02	0.115	9.38E-03
NO2.W.Spec	1.92E-14	0.789	3.46E+04	0.000	9.50E+02
Percent.H20	8.99E-01	0.128	2.55E-01	0.259	5.46E-01
Pu-239/40	2.49E-28	0.736	2.01E-05	0.171	3.33E-05
Sr-90	7.04E+00	0.000	1.79E-02	0.209	2.61E-02
TOC*	6.10E+05	0.113	2.98E+05	0.006	2.72E+04
Tc-99*	1.76E-05	0.001	2.63E-07	0.027	5.75E-08
U*	6.24E-06	0.831	7.91E+05	0.001	2.99E+04
pH	7.11E-28	0.601	3.06E-02	0.001	1.19E-03

•: Analytes with a portion of the data below 3 times the DL.
*: Analytes with a portion of the data below 10 times the DL.

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APPENDIX A

CORE COMPOSITE DATA

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Table A-1. Core Composite Data (Units µg/g except Radionuclides µCi/g). (sheet 1 of 9)

Analyte	Core 31 Comp. 1	Mean/DL	Core 31 Comp. 2	Mean/DL	Core 33 Comp. 1	Mean/DL	Core 33 Comp. 2	Mean/DL
ICP.a.Ag	2.02E+02 2.03E+02	4.05E+02	2.25E+02 2.28E+02	4.53E+02	4.48E+01 4.39E+01	8.87E+01	2.81E+01 3.19E+01	6.00E+01
ICP.a.Al	5.80E+02 5.88E+02	2.43E+02	7.03E+02 7.07E+02	2.94E+02	4.71E+02 4.73E+02	1.97E+02	4.05E+02 4.04E+02	1.69E+02
ICP.a.As	*3.13E+00 3.17E+00	NA	*3.02E+00 *2.81E+00	NA	3.39E+00 3.50E+00	1.15E+00	3.23E+00 *2.90E+00	NA
ICP.a.B	2.34E+01 3.08E+01	4.52E+01	2.53E+01 2.16E+01	3.91E+01	2.92E+01 2.96E+01	4.90E+01	3.20E+01 3.23E+01	5.36E+01
ICP.a.Ba	5.66E+01 5.75E+01	1.90E+02	6.53E+01 6.46E+01	2.17E+02	6.67E+01 6.70E+01	2.23E+02	8.67E+01 8.79E+01	2.91E+02
ICP.a.Be	*1.04E-01 1.06E-01	NA	*1.01E-01 *9.38E-02	NA	1.13E-01 1.20E-01	1.17E+00	1.08E-01 *1.00E-01	NA
ICP.a.Bi	2.34E+04 2.37E+04	3.14E+03	2.33E+04 2.32E+04	3.10E+03	2.84E+04 2.86E+04	3.80E+03	2.86E+04 2.82E+04	3.79E+03
ICP.a.Ca	2.13E+03 2.26E+03	4.99E+02	2.36E+03 2.61E+03	5.65E+02	1.49E+03 1.50E+03	3.40E+02	1.35E+03 1.34E+03	3.06E+02
ICP.a.Cd*	7.19E+00 7.25E+00	1.81E+01	7.78E+00 7.94E+00	1.97E+01	4.09E+00 4.70E+00	1.10E+01	3.64E+00 3.80E+00	9.30E+00
ICP.a.Ce•	3.39E+01 3.13E+01	3.23E+00	2.90E+01 2.83E+01	2.84E+00	4.00E+01 3.57E+01	3.75E+00	3.28E+01 3.89E+01	3.55E+00
ICP.a.Co*	3.42E+00 3.38E+00	4.25E+00	3.79E+00 1.17E+01	9.68E+00	3.15E+00 3.10E+00	3.91E+00	3.13E+00 2.70E+00	3.64E+00
ICP.a.Cr	1.83E+03 1.89E+03	2.07E+03	1.84E+03 1.84E+03	2.04E+03	2.05E+03 2.08E+03	2.29E+03	2.16E+03 2.13E+03	2.38E+03
ICP.a.Cu	2.48E+01 2.57E+01	6.31E+01	1.27E+02 3.17E+01	1.98E+02	1.64E+01 1.65E+01	4.11E+01	1.29E+01 1.30E+01	3.24E+01
ICP.a.Fe	1.89E+04 1.95E+04	1.92E+04	2.01E+04 2.00E+04	2.01E+04	1.74E+04 1.76E+04	1.75E+04	1.75E+04 1.72E+04	1.74E+04
ICP.a.K	1.08E+03 1.11E+03	9.78E+01	1.22E+03 1.20E+03	1.08E+02	1.21E+03 1.22E+03	1.08E+02	1.02E+03 1.02E+03	9.11E+01

NA: Not Available.
* : Value less than DL or less than 5 percent above the DL.
• : Analytes with a portion of the data below 3 times the DL.
⋆ : Analytes with a portion of the data below 10 times the DL.

Table A-1. Core Composite Data (Units µg/g except Radionuclides µCi/g). (sheet 2 of 9)

Analyte	Core 31 Comp. 1	Mean/DL	Core 31 Comp. 2	Mean/DL	Core 33 Comp. 1	Mean/DL	Core 33 Comp. 2	Mean/DL
ICP.a.La	3.66E+03 3.78E+03	2.66E+03	3.64E+03 3.59E+03	2.58E+03	4.61E+03 4.67E+03	3.31E+03	4.91E+03 4.86E+03	3.49E+03
ICP.a.Mg	4.32E+02 4.38E+02	1.45E+03	4.75E+02 4.82E+02	1.60E+03	3.02E+02 3.07E+02	1.02E+03	2.88E+02 2.92E+02	9.67E+02
ICP.a.Mn	6.07E+03 6.31E+03	3.10E+04	6.14E+03 6.14E+03	3.07E+04	6.65E+03 6.77E+03	3.36E+04	6.32E+03 6.23E+03	3.14E+04
ICP.a.Na	3.71E+04 3.80E+04	1.21E+04	3.87E+04 3.86E+04	1.25E+04	3.49E+04 3.50E+04	1.13E+04	3.63E+04 3.62E+04	1.17E+04
ICP.a.Ni	1.49E+02 1.54E+02	8.91E+01	1.57E+02 1.57E+02	9.24E+01	1.09E+02 1.10E+02	6.44E+01	1.09E+02 1.08E+02	6.38E+01
ICP.a.P	1.02E+04 1.00E+04	1.74E+03	9.94E+03 9.98E+03	1.72E+03	9.97E+03 9.75E+03	1.70E+03	1.13E+04 1.14E+04	1.96E+03
ICP.a.Pb	4.69E+02 4.81E+02	7.66E+01	5.42E+02 5.44E+02	8.76E+01	2.00E+02 2.01E+02	3.23E+01	1.67E+02 1.69E+02	2.71E+01
ICP.a.S	1.21E+03 1.24E+03	4.54E+02	1.26E+03 1.27E+03	4.69E+02	1.14E+03 1.14E+03	4.22E+02	1.22E+03 1.22E+03	4.52E+02
ICP.a.Sb•	3.90E+01 2.19E+01	1.72E+00	3.61E+01 3.69E+01	2.06E+00	2.00E+01 5.18E+01	2.03E+00	1.91E+01 2.61E+01	1.28E+00
ICP.a.Se	*7.92E+00 8.04E+00	NA	*7.66E+00 *7.13E+00	NA	8.60E+00 1.20E+01	1.36E+00	8.18E+00 *7.40E+00	NA
ICP.a.Si	5.29E+02 4.36E+02	3.71E+02	4.18E+02 5.24E+02	3.62E+02	5.75E+02 4.80E+02	4.06E+02	4.90E+02 2.98E+02	3.03E+02
ICP.a.Sn	4.28E+00 4.13E+00	2.63E+00	1.74E+00 3.13E+00	1.52E+00	1.81E+00 1.80E+00	1.13E+00	1.72E+00 *1.50E+00	NA
ICP.a.Sr	2.78E+02 2.85E+02	9.38E+02	2.80E+02 2.80E+02	9.33E+02	3.01E+02 3.08E+02	1.02E+03	3.37E+02 3.32E+02	1.12E+03
ICP.a.Ti	2.96E+01 2.93E+01	7.36E+01	3.34E+01 3.27E+01	8.26E+01	9.00E+00 8.80E+00	2.23E+01	6.42E+00 6.50E+00	1.62E+01
ICP.a.V	1.23E+01 1.31E+01	2.54E+01	2.13E+01 2.15E+01	4.28E+01	1.35E+01 1.42E+01	2.77E+01	9.58E+00 1.04E+01	2.00E+01

NA: Not Available.
* : Value less than DL or less than 5 percent above the DL.
• : Analytes with a portion of the data below 3 times the DL.
+ : Analytes with a portion of the data below 10 times the DL.

Table A-1. Core Composite Data (Units µg/g except Radionuclides µCi/g). (sheet 3 of 9)

Analyte	Core 31 Comp. 1	Mean/DL	Core 31 Comp. 2	Mean/DL	Core 33 Comp. 1	Mean/DL	Core 33 Comp. 2	Mean/DL
ICP.a.Zn	7.68E+01 8.20E+01	2.65E+02	9.68E+01 1.06E+02	3.38E+02	4.36E+01 4.47E+01	1.47E+02	3.45E+01 3.54E+01	1.17E+02
ICP.a.Zr	8.34E-01 8.47E-01	NA	8.07E-01 7.51E-01	NA	9.05E-01 9.20E-01	NA	8.61E-01 7.70E-01	NA
ICP.f.Ag	2.10E+02 2.18E+02	8.56E+01	2.17E+02 2.26E+02	8.86E+01	3.89E+01 4.00E+01	1.36E+01	3.69E+01 3.74E+01	1.28E+01
ICP.f.Al	6.32E+02 6.56E+02	5.37E+01	6.80E+02 7.06E+02	5.78E+01	4.83E+02 4.85E+02	4.03E+01	4.59E+02 4.59E+02	3.83E+01
ICP.f.As	*1.50E+01 *1.50E+01	NA	*1.50E+01 *1.50E+01	NA	*1.50E+01 *1.50E+01	NA	*1.50E+02 *1.50E+02	NA
ICP.f.B	*3.01E+00 *3.00E+00	NA	*2.99E+00 *2.99E+00	NA	*5.36E+00 *4.32E+00	NA	*4.58E+00 *5.10E+00	NA
ICP.f.Ba	5.72E+01 6.04E+01	3.92E+01	5.96E+01 6.15E+01	4.04E+01	6.60E+01 6.48E+01	4.36E+01	7.45E+01 7.30E+01	4.92E+01
ICP.f.Be	*5.01E-01 *5.00E-01	NA	*4.99E-01 *4.99E-01	NA	*4.99E-01 *5.00E-01	NA	*5.00E-01 *4.99E-01	NA
ICP.f.Bi	2.05E+04 2.14E+04	5.59E+02	2.02E+04 2.01E+04	5.37E+02	2.66E+04 2.63E+04	7.05E+02	2.73E+04 2.61E+04	7.12E+02
ICP.f.Ca*	2.58E+03 2.93E+03	1.25E+02	2.49E+03 2.83E+03	1.21E+02	2.50E+03 1.93E+03	9.23E+00	2.18E+03 1.92E+03	8.54E+00
ICP.f.Cd*	7.34E+00 9.16E+00	4.13E+00	7.18E+00 1.41E+01	5.32E+00	6.76E+00 6.08E+00	3.21E+00	6.86E+00 7.48E+00	3.59E+00
ICP.f.Ce	*5.06E+01 *5.05E+01	NA	*5.04E+01 *5.04E+01	NA	*5.04E+01 *5.05E+01	NA	*5.05E+01 *5.04E+01	NA
ICP.f.Co*	9.70E+00 1.05E+01	2.53E+00	1.11E+01 1.05E+01	2.70E+00	1.37E+01 1.30E+01	3.34E+00	8.90E+00 1.48E+01	2.96E+00
ICP.f.Cr	1.86E+03 1.92E+03	4.20E+02	1.67E+03 1.73E+03	3.78E+02	1.81E+03 1.76E+03	3.97E+02	1.82E+03 1.82E+03	4.04E+02
ICP.f.Cu*	3.68E+01 3.59E+01	1.82E+01	3.41E+01 3.42E+01	1.71E+01	2.16E+01 2.26E+01	9.82E+00	2.30E+01 2.61E+01	1.09E+01

NA: Not Available.
* : Value less than DL or less than 5 percent above the DL.
• : Analytes with a portion of the data below 3 times the DL.
⋆ : Analytes with a portion of the data below 10 times the DL.

Table A-1. Core Composite Data (Units µg/g except Radionuclides µCi/g). (sheet 4 of 9)

Analyte	Core 31 Comp. 1	Mean/DL	Core 31 Comp. 2	Mean/DL	Core 33 Comp. 1	Mean/DL	Core 33 Comp. 2	Mean/DL
ICP.f.Fe	2.02E+04 2.08E+04	4.10E+03	1.95E+04 1.97E+04	3.92E+03	1.62E+04 1.57E+04	6.16E+02	1.61E+04 1.61E+04	6.22E+02
ICP.f.K	*5.61E+01 *5.60E+01	NA	*5.59E+01 *5.59E+01	NA	*5.59E+01 *5.60E+01	NA	*5.60E+01 *5.59E+01	NA
ICP.f.La	3.63E+03 3.75E+03	5.27E+02	3.38E+03 3.45E+03	4.88E+02	4.58E+03 4.45E+03	6.45E+02	4.84E+03 4.78E+03	6.87E+02
ICP.f.Mg	4.24E+02 4.52E+02	2.92E+02	4.31E+02 4.56E+02	2.96E+02	2.78E+02 2.58E+02	3.46E+01	2.74E+02 2.69E+02	3.50E+01
ICP.f.Mn	6.29E+03 6.47E+03	6.38E+03	5.86E+03 6.02E+03	5.94E+03	6.29E+03 6.15E+03	4.01E+02	6.59E+03 6.59E+03	4.25E+02
ICP.f.Na	3.96E+04 4.01E+04	2.57E+03	3.85E+04 3.94E+04	2.51E+03	3.41E+04 3.36E+04	5.34E+01	3.51E+04 3.52E+04	5.54E+01
ICP.f.Ni	5.94E+03 5.61E+03	6.79E+02	7.49E+03 3.40E+03	6.41E+02	9.49E+03 9.09E+03	8.68E+01	9.81E+03 1.43E+04	1.13E+02
ICP.f.P	1.12E+04 1.19E+04	3.98E+02	1.11E+04 1.11E+04	3.83E+02	8.99E+03 9.15E+03	1.04E+02	9.91E+03 9.91E+03	1.13E+02
ICP.f.Pb+	4.27E+02 4.53E+02	1.42E+01	4.82E+02 4.86E+02	1.56E+01	2.62E+02 2.72E+02	8.61E+00	2.72E+02 2.67E+02	8.69E+00
ICP.f.S	1.35E+03 1.36E+03	1.00E+02	1.29E+03 1.33E+03	9.70E+01	1.08E+03 1.08E+03	8.00E+01	1.16E+03 1.16E+03	8.59E+01
ICP.f.Sb	*8.87E+01 *8.85E+01	NA	*8.83E+01 *8.83E+01	NA	1.29E+02 *8.85E+01	NA	*8.85E+01 *8.83E+01	NA
ICP.f.Se	*3.81E+01 *3.80E+01	NA	*3.79E+01 *3.79E+01	NA	*3.79E+01 *3.80E+01	NA	*3.80E+01 *3.79E+01	NA
ICP.f.Si	5.88E+03 6.04E+03	9.17E+02	5.78E+03 5.89E+03	8.98E+02	5.52E+03 5.39E+03	7.43E+01	5.41E+03 5.41E+03	7.37E+01
ICP.f.Sn	*8.02E+00 *8.00E+00	NA	*7.98E+00 *7.98E+00	NA	*7.98E+00 *8.00E+00	NA	*8.00E+00 *7.98E+00	NA
ICP.f.Sr	3.08E+02 2.98E+02	2.02E+02	2.70E+02 2.91E+02	1.87E+02	2.97E+02 2.84E+02	6.65E+01	2.98E+02 3.36E+02	7.25E+01

NA: Not Available.
* : Value less than DL or less than 5 percent above the DL.
• : Analytes with a portion of the data below 3 times the DL.
♣ : Analytes with a portion of the data below 10 times the DL.

Table A-1. Core Composite Data (Units µg/g except Radionuclides µCi/g). (sheet 5 of 9)

Analyte	Core 31 Comp. 1	Mean/DL	Core 31 Comp. 2	Mean/DL	Core 33 Comp. 1	Mean/DL	Core 33 Comp. 2	Mean/DL
ICP.f.Ti	7.32E+01 7.25E+01	3.64E+01	7.13E+01 7.34E+01	3.62E+01	2.25E+01 2.22E+01	1.12E+01	2.51E+01 2.31E+01	1.21E+01
ICP.f.V*	1.11E+01 1.32E+01	4.86E+00	1.55E+01 1.74E+01	6.58E+00	1.38E+01 1.69E+01	6.14E+00	1.42E+01 1.51E+01	5.86E+00
ICP.f.Zn*	9.71E+01 1.11E+02	6.94E+01	1.11E+02 1.00E+02	7.03E+01	1.10E+02 1.00E+02	7.66E+00	1.02E+02 1.19E+02	8.07E+00
ICP.f.Zr	4.01E+00 4.00E+00	NA	3.99E+00 3.99E+00	NA	*3.99E+00 *4.00E+00	NA	*4.00E+00 *3.99E+00	NA
ICP.w.Ag	7.80E-01 *5.00E-01	NA	1.26E+00 1.07E+00	2.33E+00	*4.99E-01 6.08E-01	NA	*4.99E-01 *5.00E-01	NA
ICP.w.Al•	6.99E+00 6.43E+00	2.80E+00	1.04E+01 1.02E+01	4.29E+00	1.34E+01 1.77E+01	6.48E+00	1.19E+01 1.02E+01	4.60E+00
ICP.w.As	*3.00E+00 *3.00E+00	NA	*3.00E+00 *3.00E+00	NA	*2.99E+00 *2.99E+00	NA	*2.99E+00 *3.00E+00	NA
ICP.w.B*	3.50E+00 3.11E+00	5.51E+00	3.27E+00 3.12E+00	5.33E+00	5.54E+00 5.54E+00	9.23E+00	4.44E+00 4.06E+00	7.08E+00
ICP.w.Ba	*3.09E-01 *3.00E-01	NA	*3.00E-01 5.32E-01	NA	3.78E-01 7.15E-01	1.82E+00	5.32E-01 5.01E-01	1.72E+00
ICP.w.Be	*1.00E-01 *9.99E-02	NA	*9.99E-02 *9.99E-02	NA	*9.98E-02 *9.98E-02	NA	*9.98E-02 *9.99E-02	NA
ICP.w.Bi	8.34E+01 1.47E+02	1.54E+01	1.76E+02 2.05E+02	2.54E+01	2.05E+02 2.58E+02	3.09E+01	2.73E+02 2.67E+02	3.60E+01
ICP.w.Ca*	5.05E+01 5.12E+01	1.16E+01	5.43E+01 6.89E+01	1.40E+01	7.16E+01 6.13E+01	1.51E+01	9.35E+01 4.15E+01	1.53E+01
ICP.w.Cd	*4.00E-01 *4.00E-01	NA	*4.00E-01 *4.00E-01	NA	*3.99E-01 *3.99E-01	NA	*3.99E-01 *4.00E-01	NA
ICP.w.Ce	*1.01E+01 *1.01E+01	NA	*1.01E+01 *1.01E+01	NA	*1.01E+01 *1.01E+01	NA	*1.01E+01 *1.01E+01	NA
ICP.w.Co	*8.00E-01 *7.99E-01	NA	*7.99E-01 8.51E-01	NA	*7.98E-01 8.43E-01	NA	8.50E-01 *7.99E-01	NA

NA: Not Available.
* : Value less than DL or less than 5 percent above the DL.
• : Analytes with a portion of the data below 3 times the DL.
* : Analytes with a portion of the data below 10 times the DL.

Table A-1. Core Composite Data (Units µg/g except Radionuclides µCi/g). (sheet 6 of 9)

Analyte	Core 31 Comp. 1	Mean/DL	Core 31 Comp. 2	Mean/DL	Core 33 Comp. 1	Mean/DL	Core 33 Comp. 2	Mean/DL
ICP.w.Cr	2.11E+02 2.07E+02	2.32E+02	2.28E+02 2.30E+02	2.54E+02	2.22E+02 2.26E+02	2.49E+02	2.12E+02 2.09E+02	2.34E+02
ICP.w.Cu	*4.00E-01 *4.00E-01	NA	*4.00E-01 *4.00E-01	NA	*3.99E-01 *3.99E-01	NA	*3.99E-01 *4.00E-01	NA
ICP.w.Fe	5.70E+01 1.02E+02	7.95E+01	1.30E+02 1.51E+02	1.41E+02	1.16E+02 1.47E+02	1.32E+02	1.60E+02 1.58E+02	1.59E+02
ICP.w.K	7.40E+02 7.28E+02	6.55E+01	7.83E+02 7.83E+02	6.99E+01	7.04E+02 7.19E+02	6.35E+01	6.47E+02 6.50E+02	5.79E+01
ICP.w.La*	5.00E+00 7.05E+00	4.30E+00	7.69E+00 9.35E+00	6.09E+00	1.22E+01 1.55E+01	9.89E+00	1.57E+01 1.58E+01	1.13E+01
ICP.w.Mg*	2.67E+00 3.22E+00	9.82E+00	3.66E+00 4.23E+00	1.32E+01	3.60E+00 4.08E+00	1.28E+01	3.95E+00 3.72E+00	1.28E+01
ICP.w.Mn	1.01E+01 1.93E+01	7.35E+01	2.31E+01 2.70E+01	1.25E+02	2.04E+01 3.04E+01	1.27E+02	3.34E+01 3.42E+01	1.69E+02
ICP.w.Na	3.41E+04 3.39E+04	1.10E+04	3.51E+04 3.50E+04	1.13E+04	3.06E+04 3.09E+04	9.92E+03	3.19E+04 3.22E+04	1.03E+04
ICP.w.Ni	*1.70E+00 *1.70E+00	NA	*1.70E+00 *1.70E+00	NA	*1.70E+00 *1.70E+00	NA	*1.70E+00 *1.70E+00	NA
ICP.w.P	5.63E+03 5.89E+03	9.93E+02	5.81E+03 6.11E+03	1.03E+03	5.26E+03 5.34E+03	9.14E+02	5.66E+03 5.74E+03	9.83E+02
ICP.w.Pb	7.91E+00 *6.19E+00	NA	6.93E+00 8.92E+00	1.28E+00	*6.19E+00 *6.28E+00	NA	*6.19E+00 *6.19E+00	NA
ICP.w.S	1.21E+03 1.18E+03	4.43E+02	1.19E+03 1.21E+03	4.44E+02	1.05E+03 1.07E+03	3.93E+02	1.14E+03 1.14E+03	4.22E+02
ICP.w.Sb	*1.77E+01 *1.77E+01	NA	*1.77E+01 *1.77E+01	NA	*1.77E+01 *1.77E+01	NA	*1.77E+01 *1.77E+01	NA
ICP.w.Se	*7.60E+00 *7.59E+00	NA	*7.59E+00 8.44E+00	NA	*7.58E+00 *7.58E+00	NA	*7.58E+00 *7.59E+00	NA
ICP.w.Si	3.45E+02 5.30E+02	3.37E+02	5.30E+02 5.89E+02	4.30E+02	6.68E+02 6.71E+02	5.15E+02	6.22E+02 6.18E+02	4.77E+02

NA: Not Available.
* : Value less than DL or less than 5 percent above the DL.
• : Analytes with a portion of the data below 3 times the DL.
★ : Analytes with a portion of the data below 10 times the DL.

Table A-1. Core Composite Data (Units µg/g except Radionuclides µCi/g). (sheet 7 of 9)

Analyte	Core 31 Comp. 1	Mean/DL	Core 31 Comp. 2	Mean/DL	Core 33 Comp. 1	Mean/DL	Core 33 Comp. 2	Mean/DL
ICP.w.Sn	*1.60E+00 *1.60E+00	NA	*1.60E+00 *1.60E+00	NA	*1.60E+00 *1.60E+00	NA	*1.60E+00 *1.60E+00	NA
ICP.w.Sr*	9.37E-01 1.48E+00	4.03E+00	1.97E+00 2.29E+00	7.10E+00	1.97E+00 2.38E+00	7.25E+00	2.39E+00 2.29E+00	7.80E+00
ICP.w.Ti	*4.00E-01 *4.00E-01	NA	*4.00E-01 *4.00E-01	NA	*3.99E-01 *3.99E-01	NA	*3.99E-01 *4.00E-01	NA
ICP.w.V	*5.00E-01 *5.00E-01	NA	5.94E-01 8.20E-01	1.41E+00	*4.99E-01 *4.99E-01	NA	9.21E-01 6.76E-01	1.60E+00
ICP.w.Zn	*3.00E-01 *3.00E-01	NA	*3.00E-01 *3.00E-01	NA	*2.99E-01 *2.99E-01	NA	*2.99E-01 *3.00E-01	NA
ICP.w.Zr	8.00E-01 7.99E-01	NA	7.99E-01 7.99E-01	NA	7.98E-01 7.98E-01	NA	7.98E-01 7.99E-01	NA
IC.w.Cl	4.73E+02 4.66E+02	4.70E+01	5.18E+02 4.75E+02	4.97E+01	4.40E+02 3.62E+02	4.01E+01	4.40E+02 4.23E+02	4.32E+01
IC.w.F	3.14E+03 3.03E+03	3.09E+02	3.16E+03 3.09E+03	3.13E+02	1.47E+03 1.26E+03	1.37E+02	1.67E+03 1.59E+03	1.63E+02
IC.w.NO2	<1.10E+03 <1.10E+03	NA	8.71E+02 <1.10E+03	NA	8.42E+02 7.04E+02	7.73E+00	7.59E+02 7.04E+02	7.32E+00
IC.w.NO3	4.45E+04 4.41E+04	4.43E+02	4.36E+04 4.39E+04	4.38E+02	3.76E+04 3.61E+04	3.69E+02	3.98E+04 4.03E+04	4.01E+02
IC.w.PO4	1.56E+04 1.67E+04	1.62E+02	1.71E+04 1.77E+04	1.74E+02	1.36E+04 1.35E+04	1.36E+02	1.51E+04 1.50E+04	1.51E+02
IC.w.SO4	3.69E+03 3.69E+03	3.69E+01	3.72E+03 3.75E+03	3.74E+01	3.23E+03 3.34E+03	3.29E+01	3.41E+03 3.52E+03	3.47E+01
GEA.Am-241	4.37E-02 4.80E-02	4.02E+01	4.02E-02 4.16E-02	3.59E+01	3.95E-02 3.79E-02	3.39E+01	4.24E-02 4.61E-02	3.88E+02
GEA.Co-60	<4.21E-04 <3.39E-04	NA	<3.85E-04 <3.75E-04	NA	<3.45E-04 <3.70E-04	NA	<3.29E-04 <3.45E-04	NA
GEA.Cs-137	2.12E-01 2.11E-01	5.72E+02	2.36E-01 2.38E-01	6.41E+02	1.15E-01 1.12E-01	3.07E+02	1.03E-01 1.04E-01	2.80E+02

NA: Not Available.
* : Value less than DL or less than 5 percent above the DL.
• : Analytes with a portion of the data below 3 times the DL.
★ : Analytes with a portion of the data below 10 times the DL.

Table A-1. Core Composite Data (Units µg/g except Radionuclides µCi/g). (sheet 8 of 9)

Analyte	Core 31 Comp. 1	Mean/DL	Core 31 Comp. 2	Mean/DL	Core 33 Comp. 1	Mean/DL	Core 33 Comp. 2	Mean/DL
GEA.Eu-154	*1.09E-03 *1.07E-03	NA	<1.06E-03 3.24E-03	NA	<1.11E-03 <1.01E-03	NA	<1.05E-03 <9.64E-04	NA
GEA.Eu-155	<2.08E-03 <2.09E-03	NA	<2.13E-03 <2.12E-03	NA	2.97E-03 3.16E-03	5.15E+00	<1.49E-03 <1.49E-03	NA
Gross.alpha	3.59E-01 3.58E-01	5.05E+01	3.50E-01 3.69E-01	5.06E+01	3.78E-01 3.76E-01	7.11E+02	3.97E-01 3.97E-01	7.49E+02
Gross.beta	2.04E+01 2.07E+01	2.20E+02	2.16E+01 2.13E+01	2.29E+02	9.86E+00 9.32E+00	1.56E+02	8.95E+00 8.71E+00	1.44E+02
TIC.w.CO3	<5.00E+02 6.50E+02	NA	6.49E+02 9.99E+02	1.65E+00	7.49E+02 8.98E+02	1.65E+00	7.99E+02 1.40E+03	2.20E+00
TGA.%.H2O	6.13E+01 8.53E+01	NA	6.92E+01 7.12E+01	NA	8.10E+01 8.22E+01	NA	7.86E+01 8.30E+01	NA
Am-241♦	4.43E-02 3.85E-02	7.26E+00	4.66E-02 3.96E-02	7.56E+00	3.71E-02 3.94E-02	6.59E+00	4.44E-02 5.11E-02	7.96E+00
C-14	3.80E-04 <2.25E-04	NA	<2.23E-04 <2.25E-04	NA	<2.25E-04 <2.25E-04	NA	<2.25E-04 <2.25E-04	NA
CN	<4.50E+00 <4.00E+00	NA	<3.41E+00 <3.57E+00	NA	<4.90E+00 <4.81E+00	NA	<4.76E+00 <4.61E+00	NA
H3	<3.15E-04 <3.15E-04	NA	<3.12E-04 <3.15E-04	NA	<3.15E-04 <3.15E-04	NA	<3.15E-04 <3.15E-04	NA
Hg♦	1.70E+00 1.48E+00	1.27E+01	1.79E+00 1.88E+00	1.47E+01	1.18E+00 1.22E+00	9.60E+00	1.02E+00 1.15E+00	8.68E+00
I-129	<1.74E-02 <1.72E-02	NA	<2.40E-02 <1.92E-02	NA	<2.15E-02 <1.44E-02	NA	<1.75E-02 <2.17E-02	NA
NH3	<4.50E+03 <4.50E+03	NA	<4.50E+03 <4.50E+03	NA	<4.50E+03 <4.50E+03	NA	<4.50E+03 <4.50E+03	NA
NO2.w.Spec	9.49E+02 9.55E+02	1.90E+01	5.22E+02 5.27E+02	1.05E+01	8.72E+02 8.84E+02	1.76E+01	7.74E+02 8.60E+02	1.63E+01
Np-237	<3.25E-02 <3.24E-02	NA	<3.24E-02 <3.24E-02	NA	<3.24E-02 <3.24E-02	NA	<3.24E-02 <3.24E-02	NA

NA: Not Available.
* : Value less than DL or less than 5 percent above the DL.
♦ : Analytes with a portion of the data below 3 times the DL.
♣ : Analytes with a portion of the data below 10 times the DL.

Table A-1. Core Composite Data (Units µg/g except Radionuclides µCi/g). (sheet 9 of 9)

Analyte	Core 31 Comp. 1	Mean/DL	Core 31 Comp. 2	Mean/DL	Core 33 Comp. 1	Mean/DL	Core 33 Comp. 2	Mean/DL
Percent.H2O	7.48E+01 7.44E+01	NA	7.59E+01 7.59E+01	NA	7.72E+01 7.57E+01	NA	7.78E+01 7.64E+01	NA
Pu-238	<1.04E-02 <1.07E-02	NA	<1.03E-02 <1.04E-02	NA	<1.05E-02 <1.00E-02	NA	<1.13E-02 <1.04E-02	NA
Pu-239/40	1.35E-01 1.41E-01	3.83E+01	1.34E-01 1.37E-01	3.76E+01	1.39E-01 1.29E-01	3.83E+01	1.53E-01 1.62E-01	4.21E+01
Se	<6.05E-05 <6.11E-05	NA	6.17E-05 6.31E-05	1.11E+00	<1.23E-04 <1.26E-04	NA	<1.29E-04 <1.26E-04	NA
Sr-90	6.97E+00 7.34E+00	1.01E+03	7.55E+00 7.31E+00	1.62E+03	3.67E+00 3.62E+00	1.70E+03	3.37E+00 3.48E+00	1.59E+03
TOC*	3.30E+03 3.68E+03	6.98E+00	4.12E+03 3.85E+03	7.97E+00	2.00E+03 2.00E+03	4.00E+00	3.00E+03 3.00E+03	6.00E+00
Tc-99*	4.95E-03 5.33E-03	6.05E+00	4.90E-03 4.56E-03	5.56E+00	1.12E-02 1.16E-02	2.48E+00	1.03E-02 1.05E-02	2.26E+00
U*	2.14E+03 2.21E+03	8.70E+00	4.00E+03 3.75E+03	1.55E+01	3.01E+03 3.34E+03	9.34E+00	2.07E+03 1.82E+03	5.72E+00
pH	1.02E+01 1.02E+01	NA	9.91E+00 9.94E+00	NA	1.01E+01 1.00E+01	NA	9.72E+00 9.81E+00	NA

NA: Not Available.
* : Value less than DL or less than 5 percent above the DL.
• : Analytes with a portion of the data below 3 times the DL.
⋆ : Analytes with a portion of the data below 10 times the DL.

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APPENDIX B

CORE COMPOSITE DATA PLOTS

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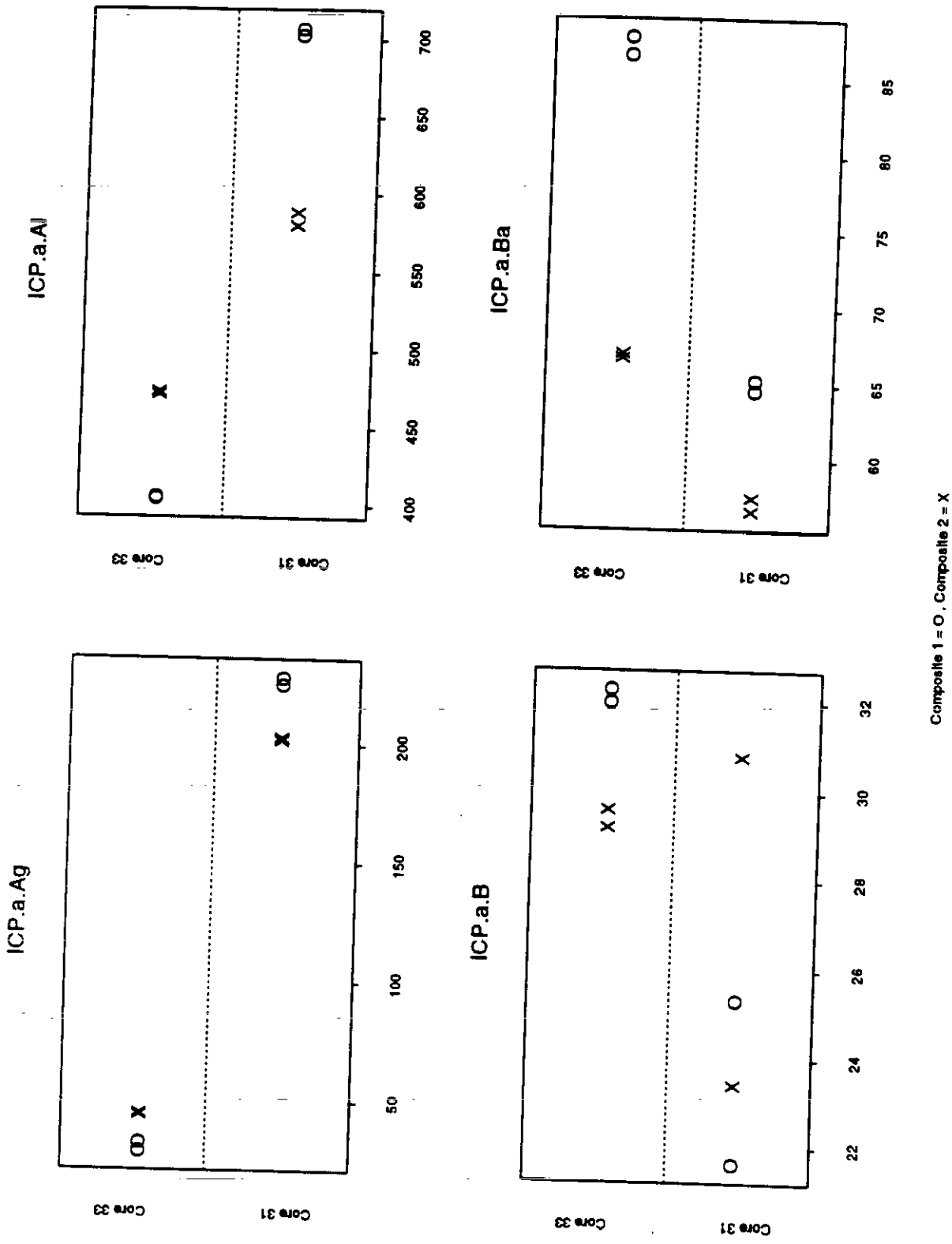
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650
700
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ICP.a.Ba
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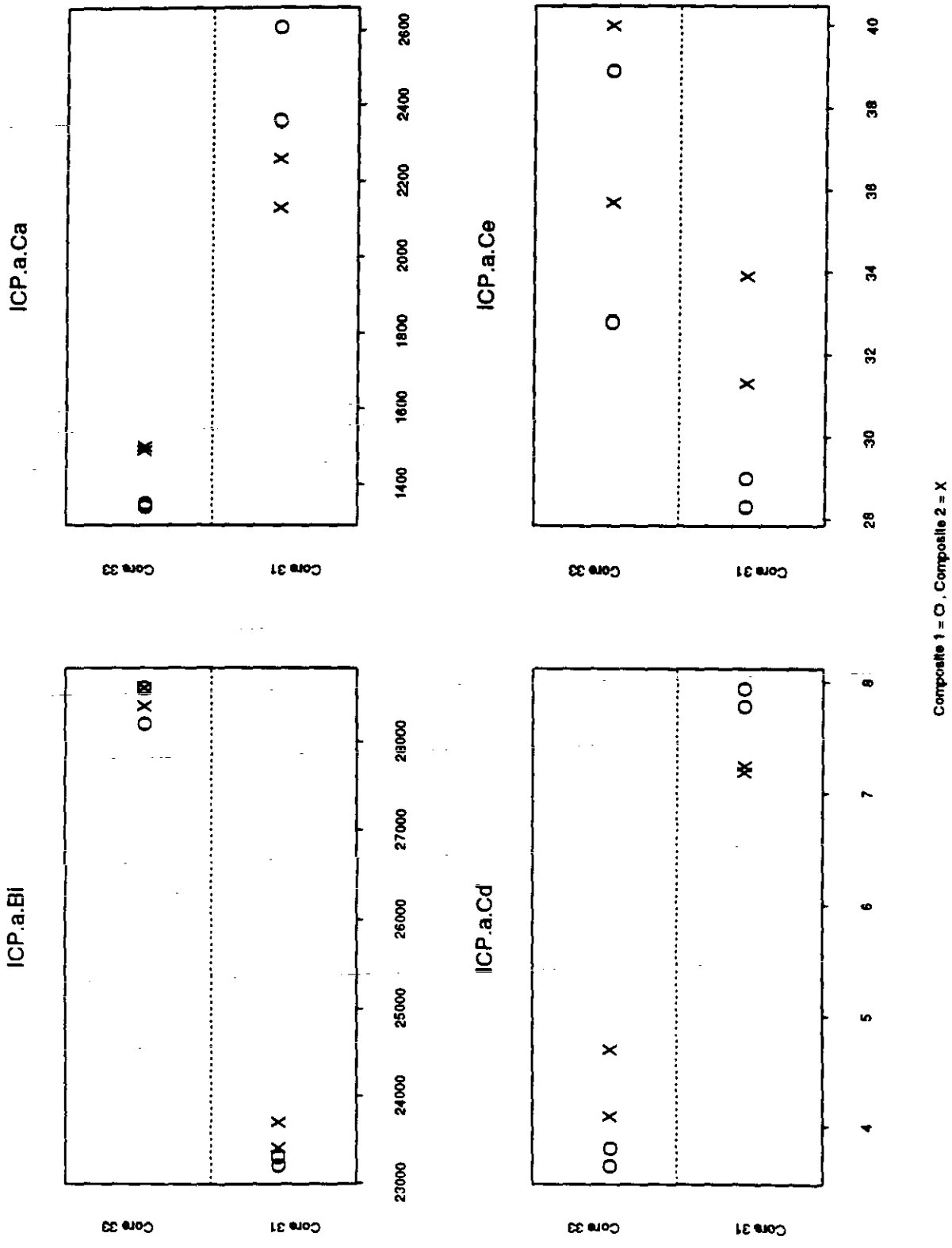
65
70
75
80
85
Core 31
Core 33
ICP.a.Ag
50
100
150
200
Core 31
Core 33
ICP.a.B
22
24
26
28
30
32
Core 31
Core 33
Composite 1 = O , Composite 2 = X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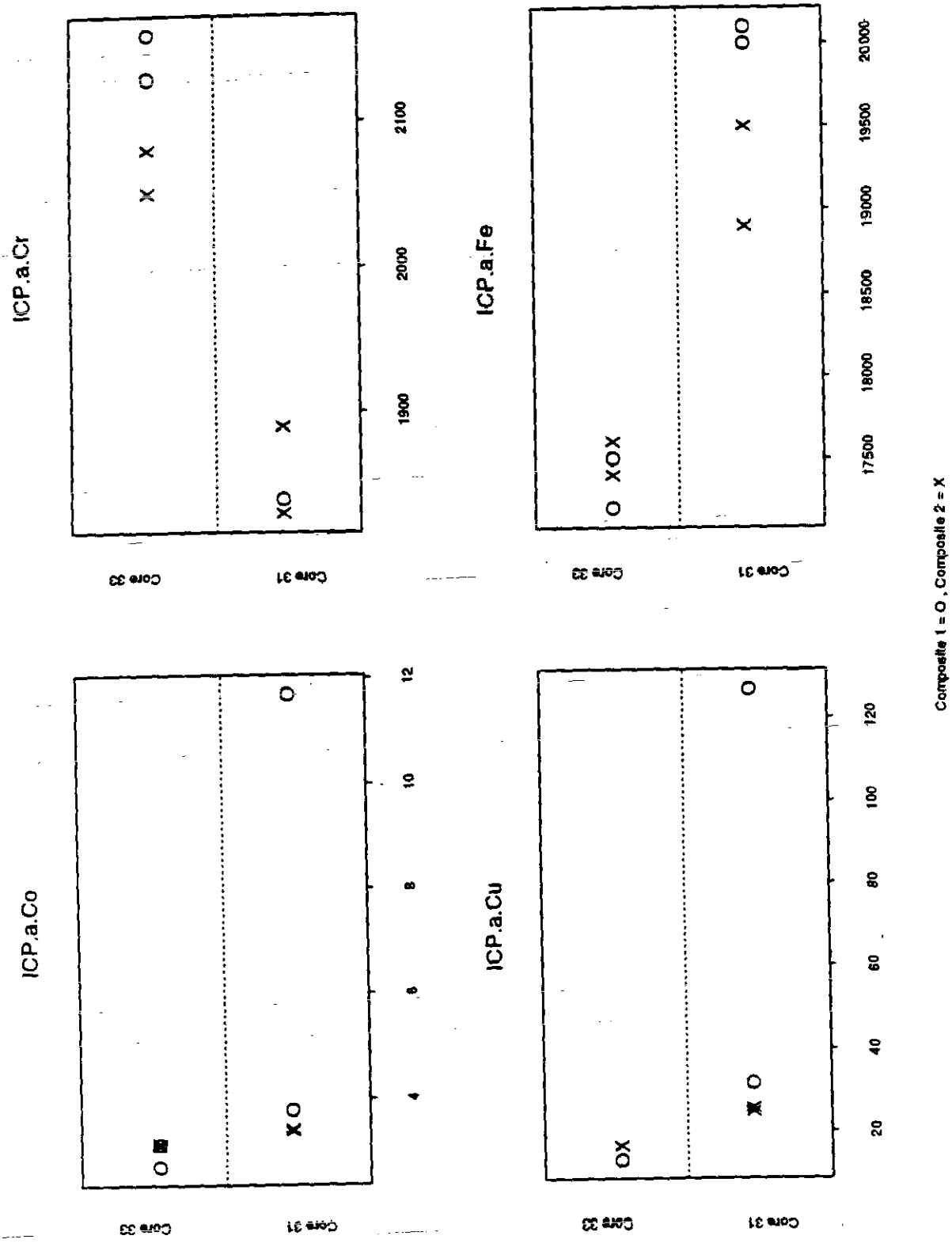
ICP.a.Bi
ICP.a.Cd
Core 31
Core 33
Composite 1 = O , Composite 2 = X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2100
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Core 33
ICP.a.Fe
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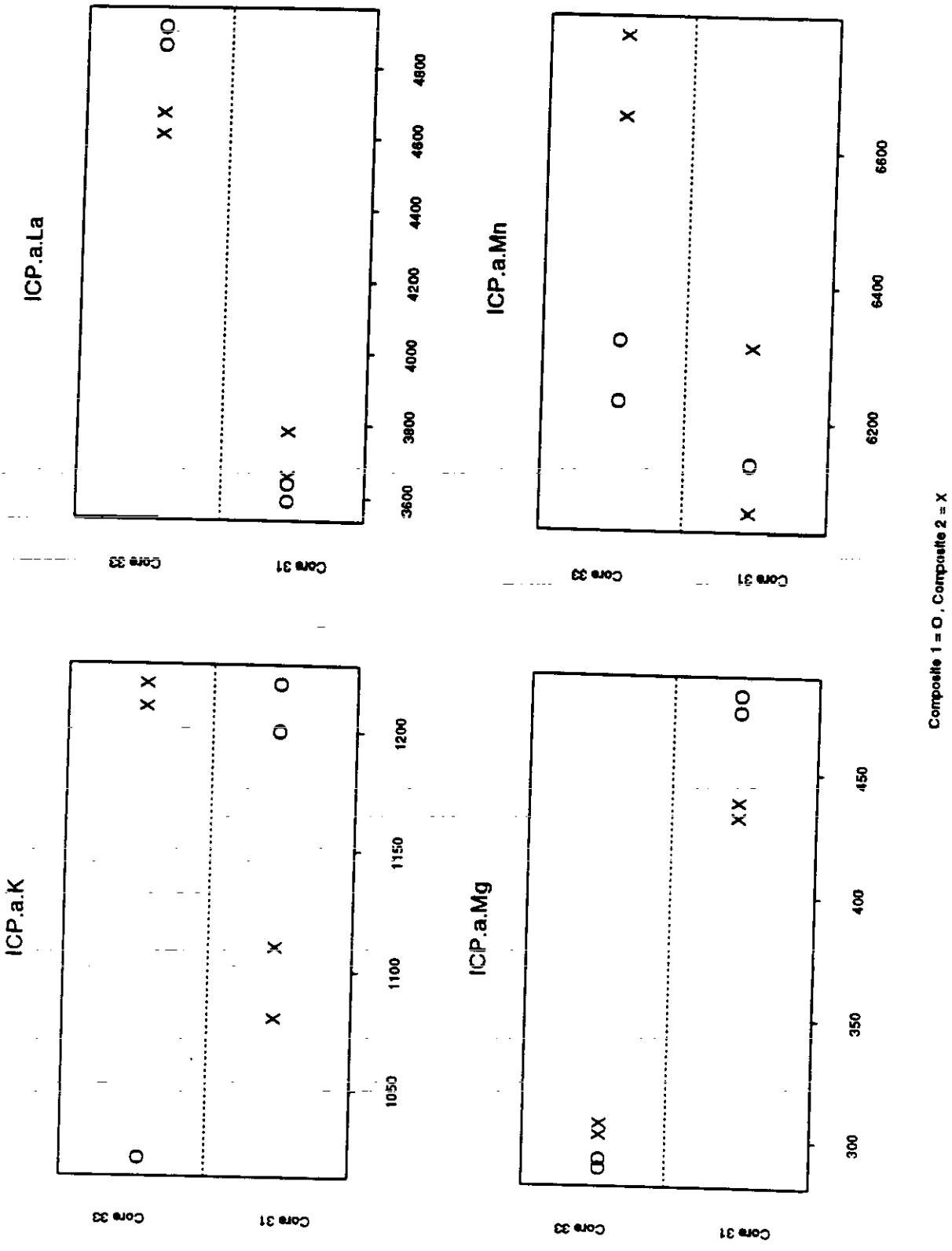
18000
18500
19000
19500
20000
Core 31
Core 33
ICP.a.Co
4
6
8
10
12
Core 31
Core 33
ICP.a.Cu
20
40
60
80
100
120
Core 31
Core 33
Composite 1 = O , Composite 2 = X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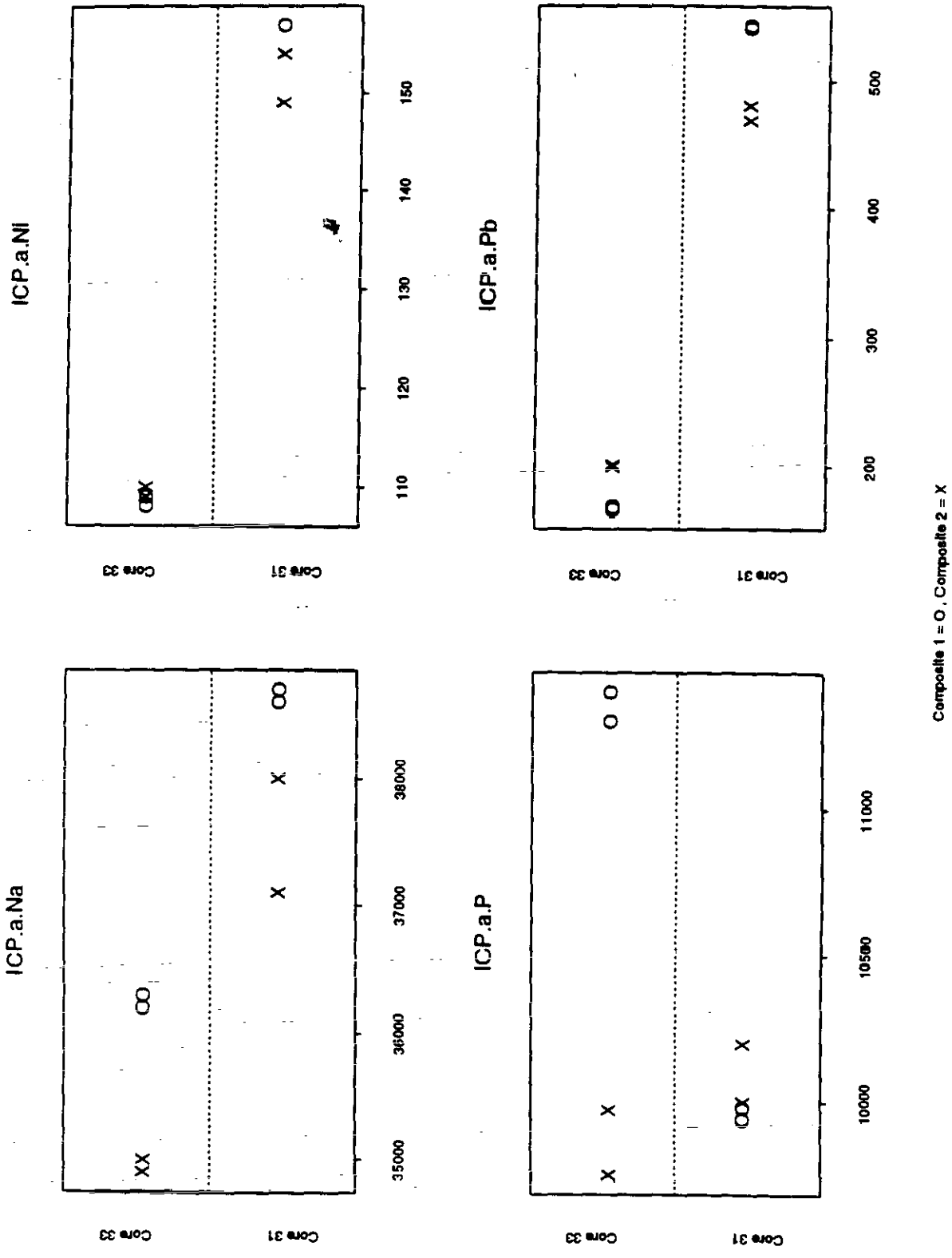
ICP.a.Mn
ICP.a.K
ICP.a.Mg
Core 31
Core 33
Composite 1 = O , Composite 2 = X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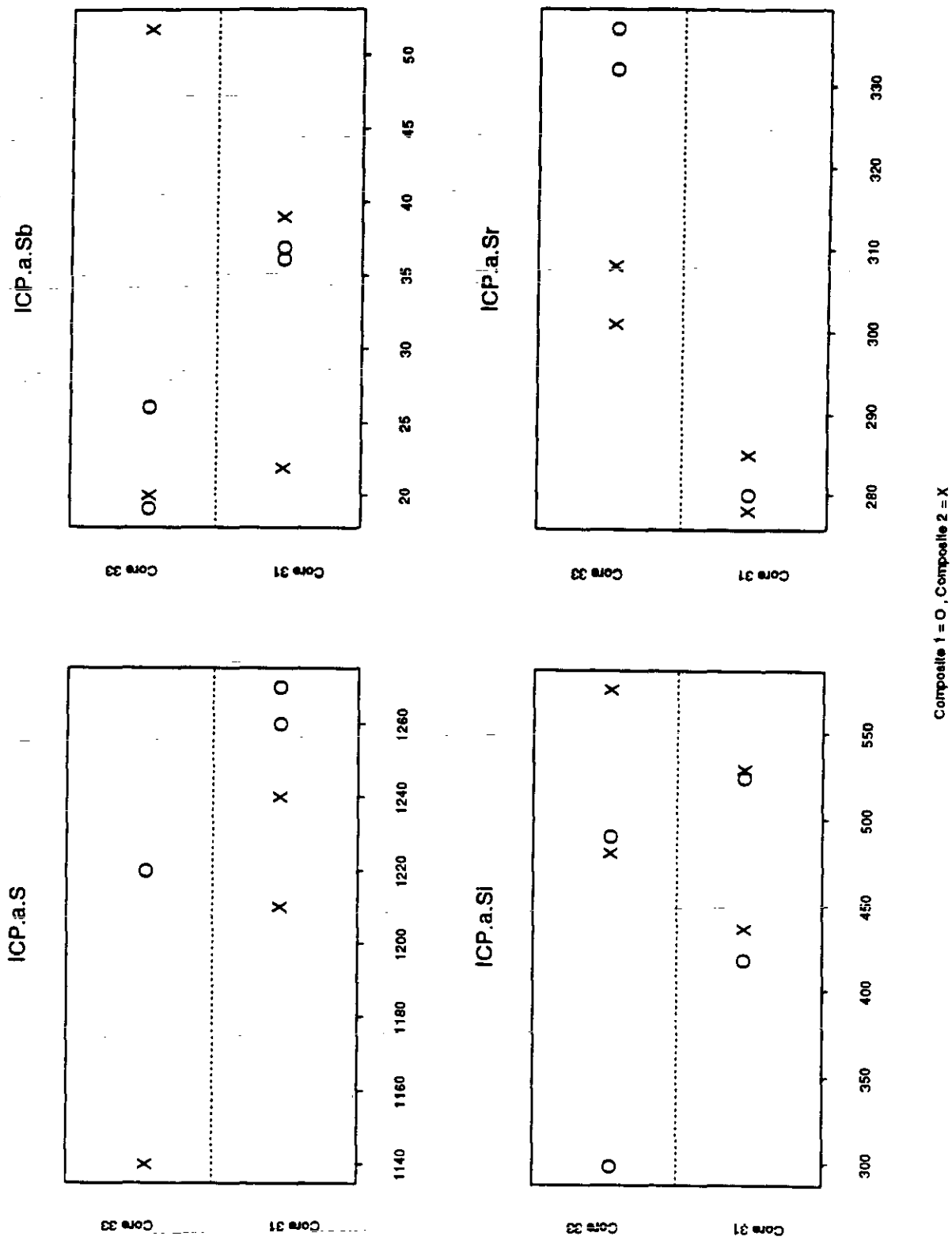
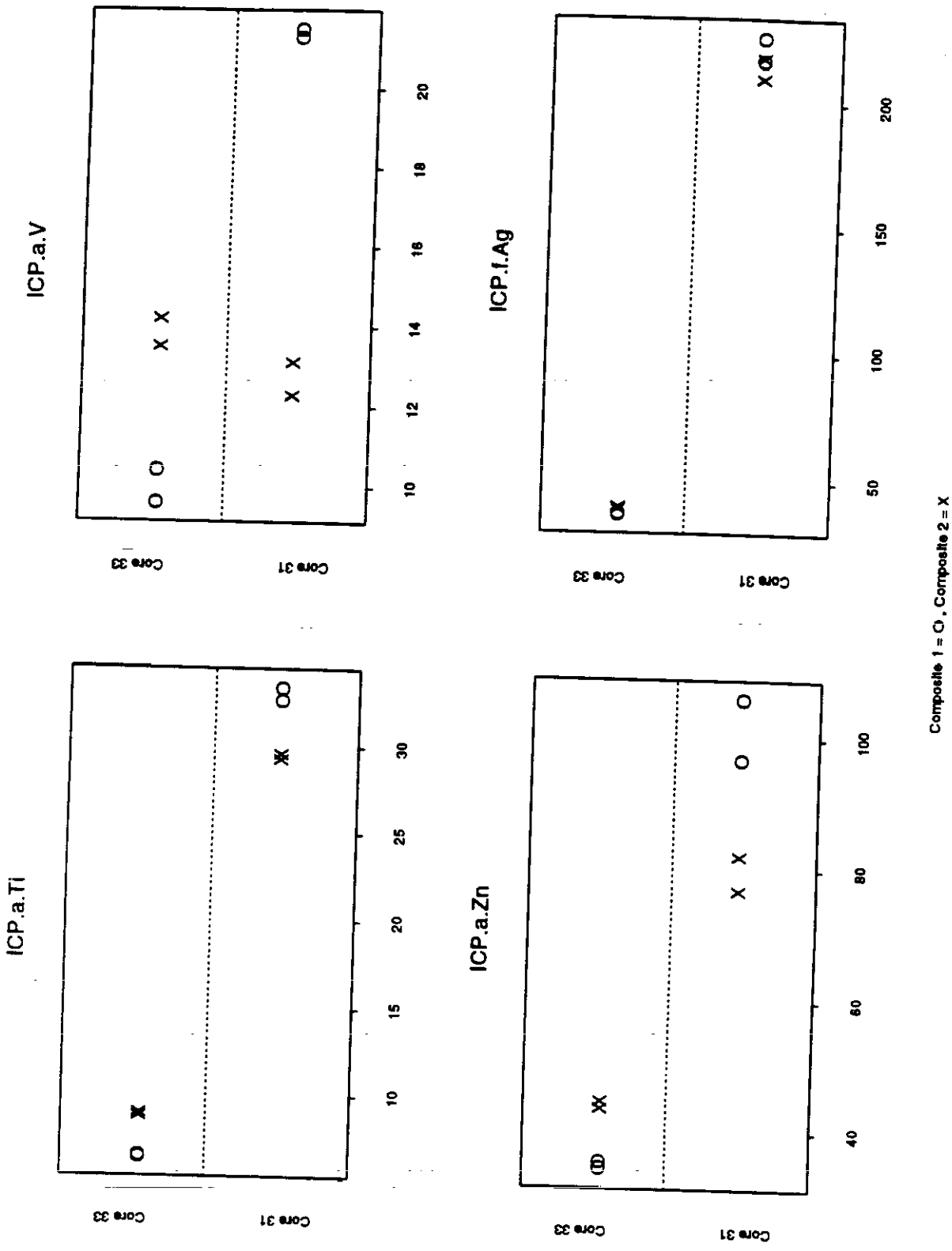
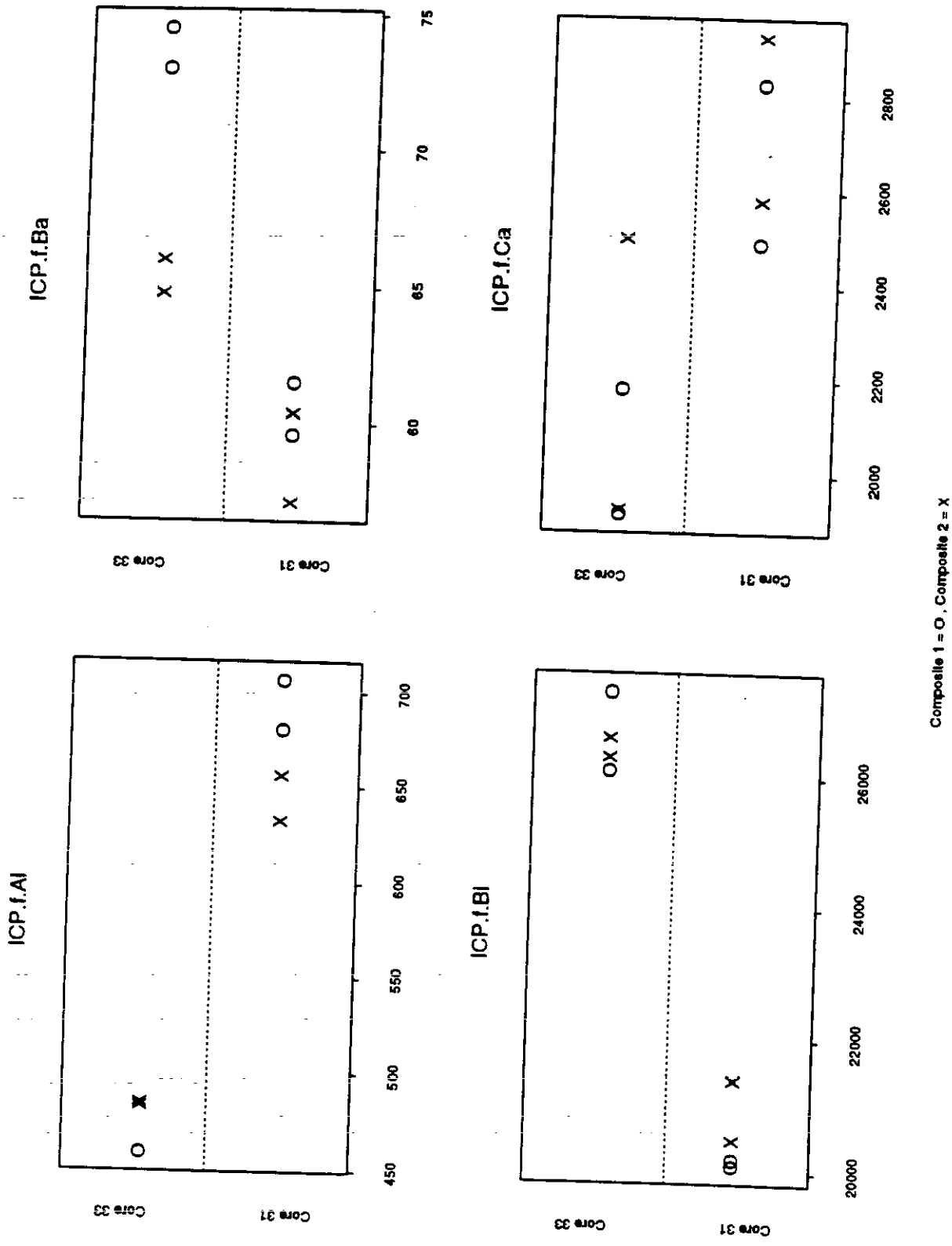
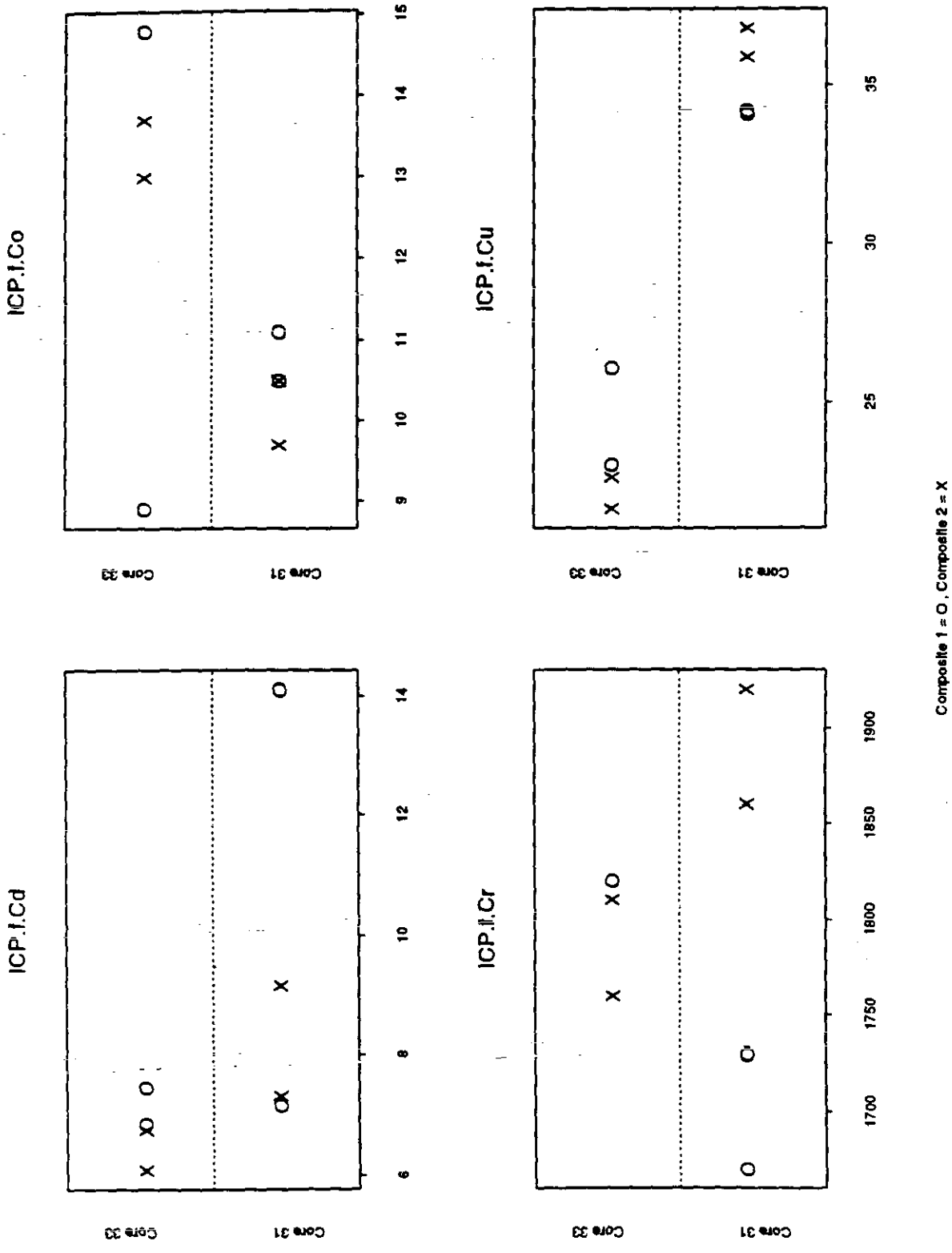
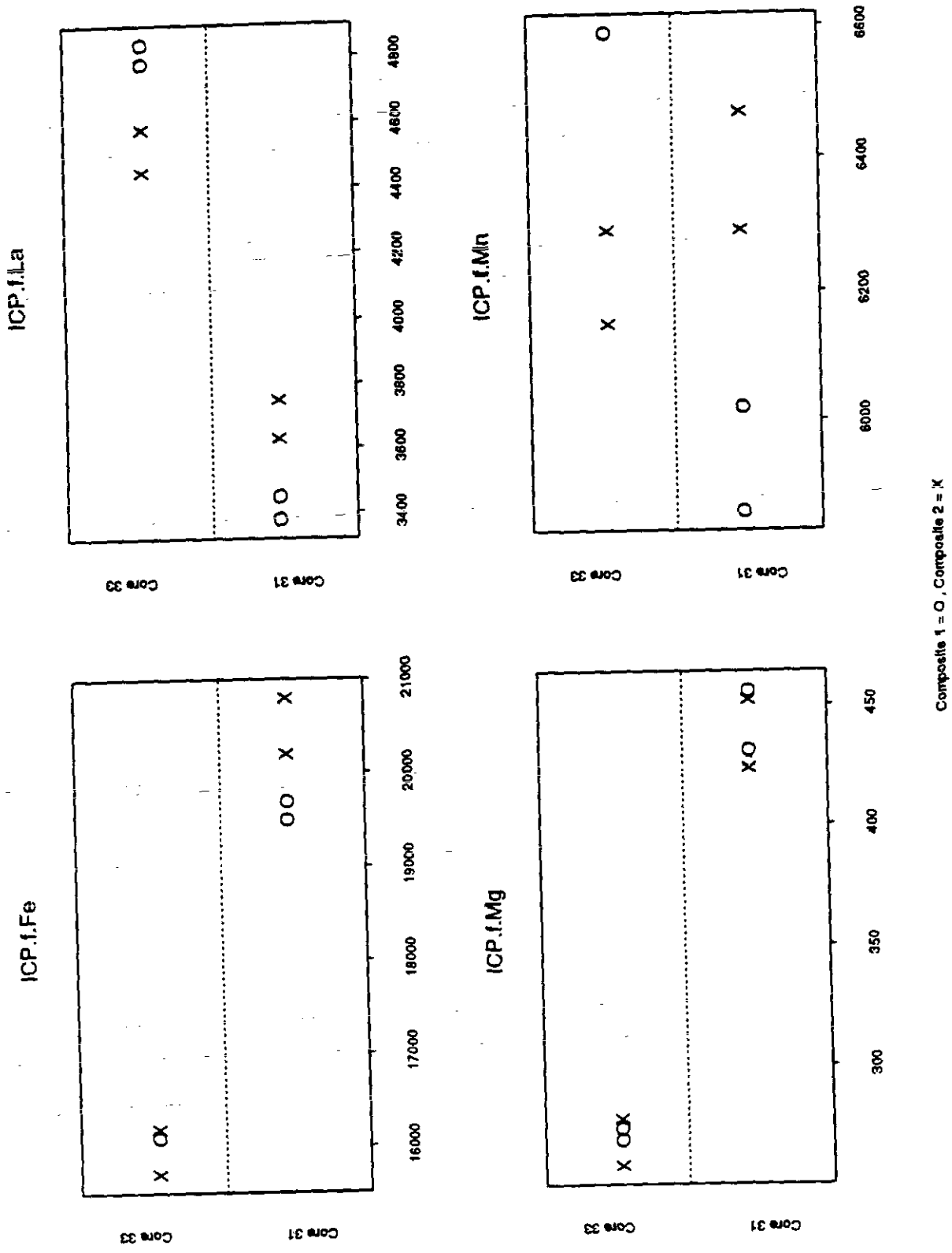
130
140
150
Core 31
Core 33
ICP.a.Pb
200
300
400
500
Core 31
Core 33
ICP.a.Na
35000
36000
37000
38000
Core 31
Core 33
ICP.a.P
10000
10500
11000
Core 31
Core 33
Composite 1 = O , Composite 2 = X

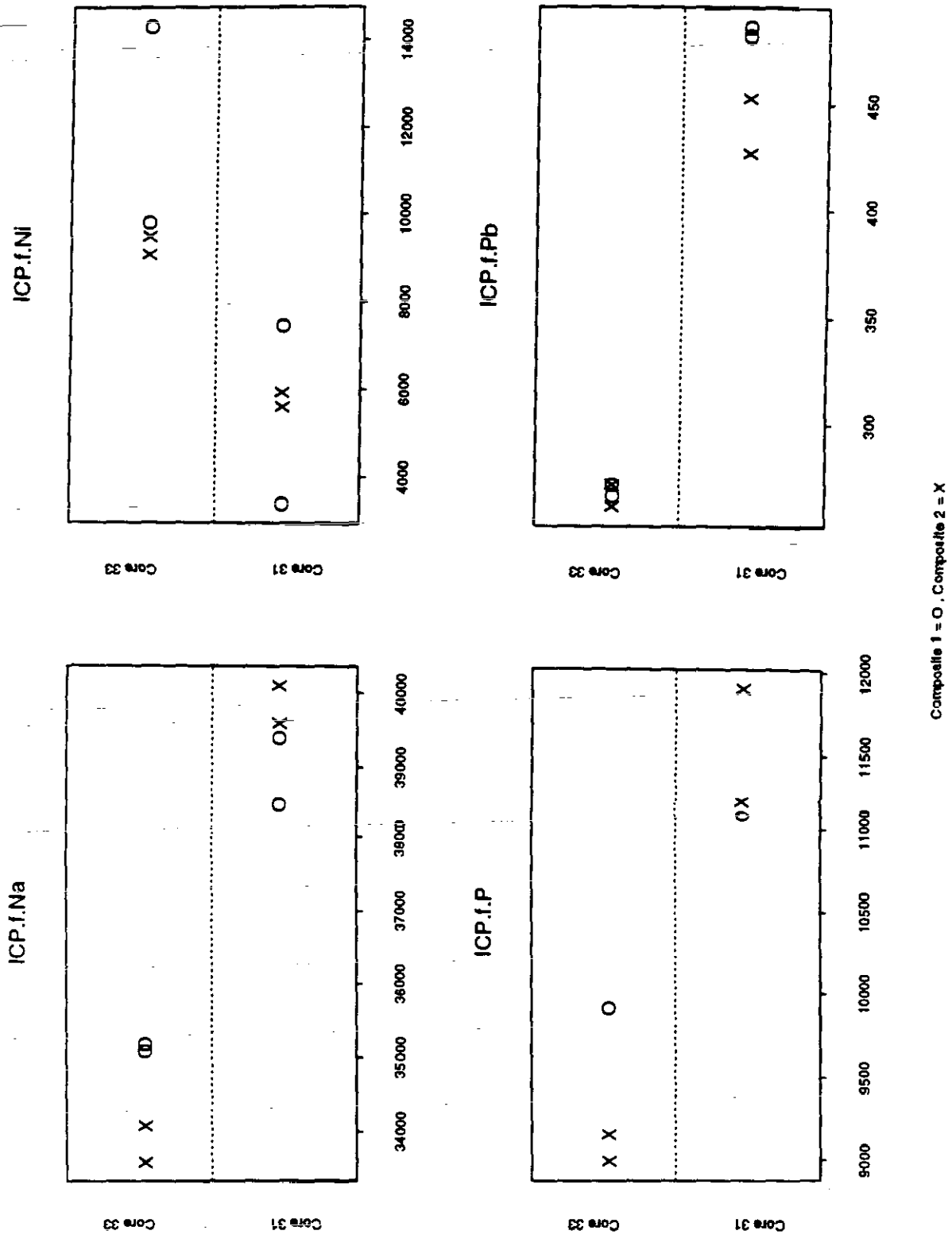

ICP.a.Sb
ICP.a.Sr
ICP.a.S
ICP.a.Si
Core 31
Core 33
Composite 1 = O , Composite 2 = X

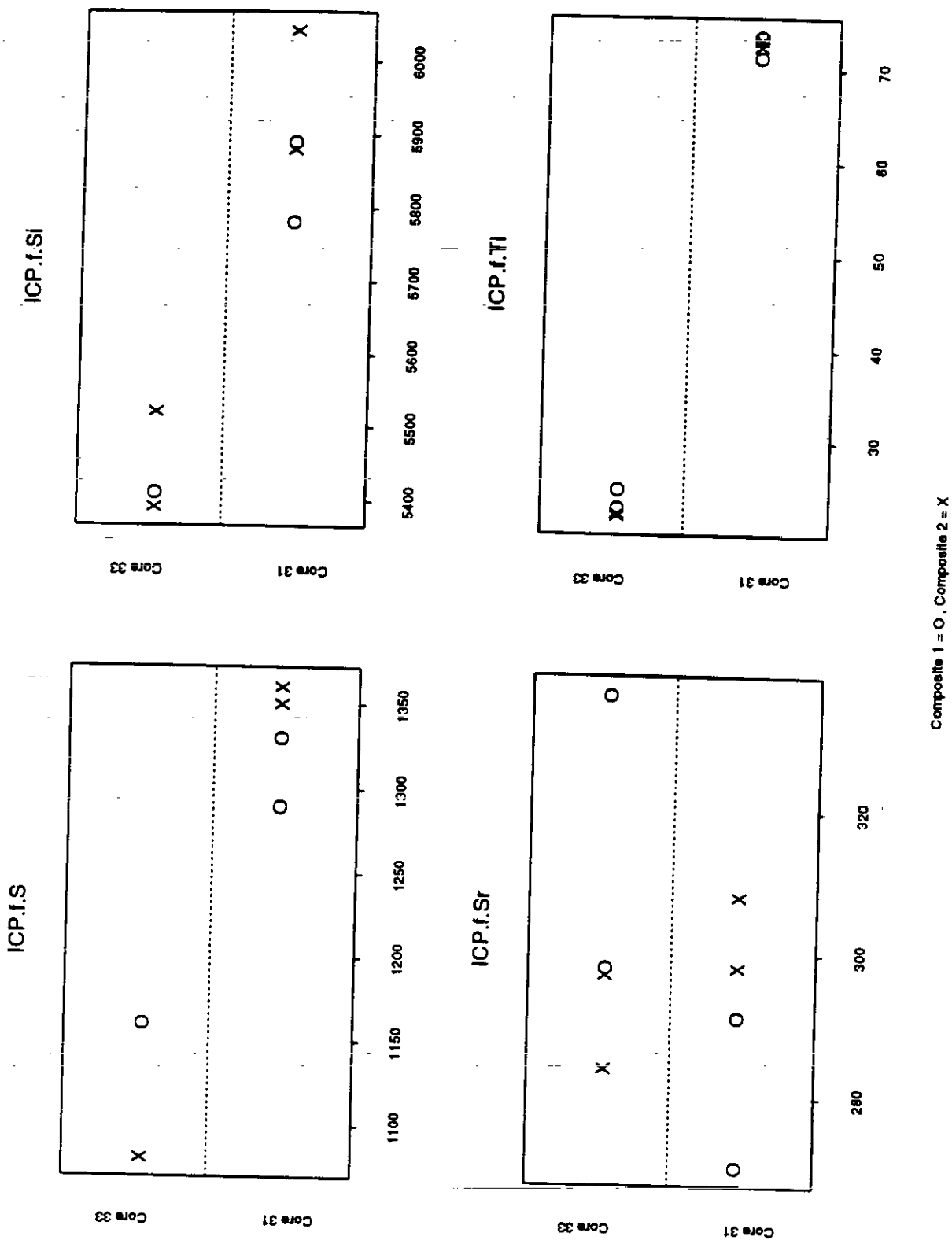

ICP.a.V
ICP.f.Ag
ICP.a.Ti
ICP.a.Zn
Core 31
Core 33
Composite 1 = O , Composite 2 = X

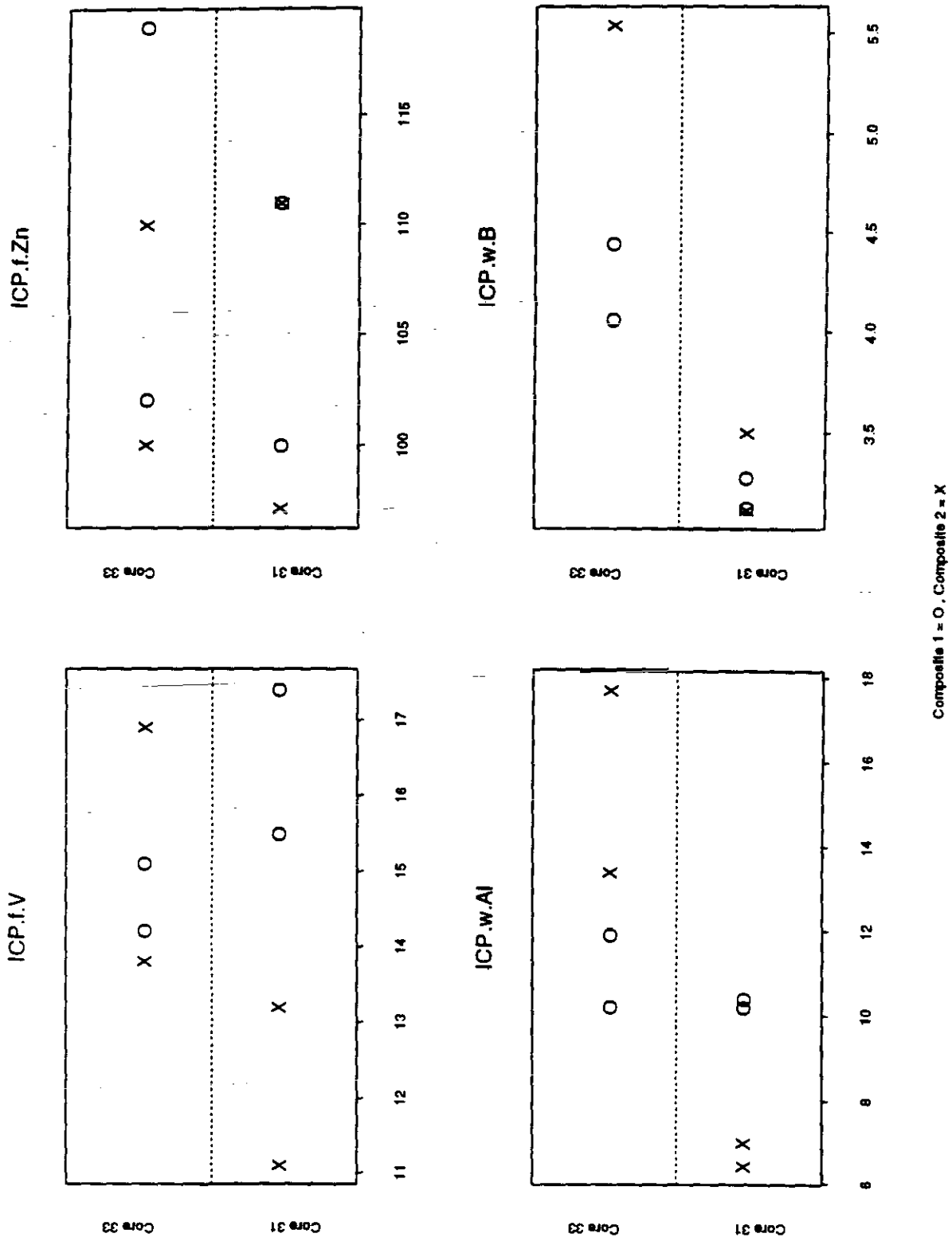

ICP.f.Ba
60
65
70
75
Core 31
Core 33
ICP.f.Ca
2000
2200
2400
2600
2800
Core 31
Core 33
ICP.f.Al
450
500
550
600
650
700
Core 31
Core 33
ICP.f.Bl
20000
22000
24000
26000
Core 31
Core 33
Composite 1 = O , Composite 2 = X

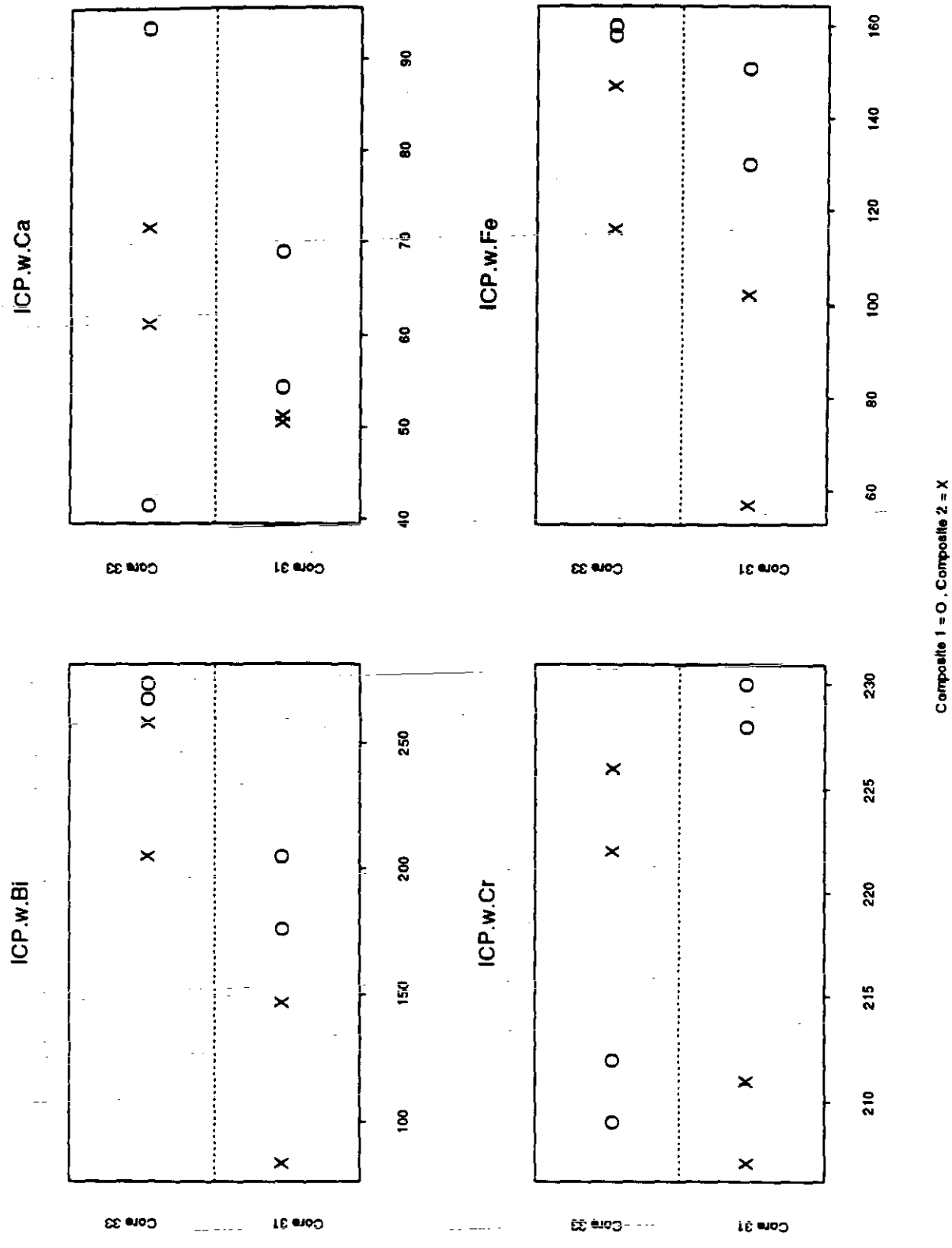

ICP.f.Co
ICP.f.Cu
ICP.f.Cd
ICP.ff.Cr
Core 31
Core 33
Composite 1 = O, Composite 2 = X

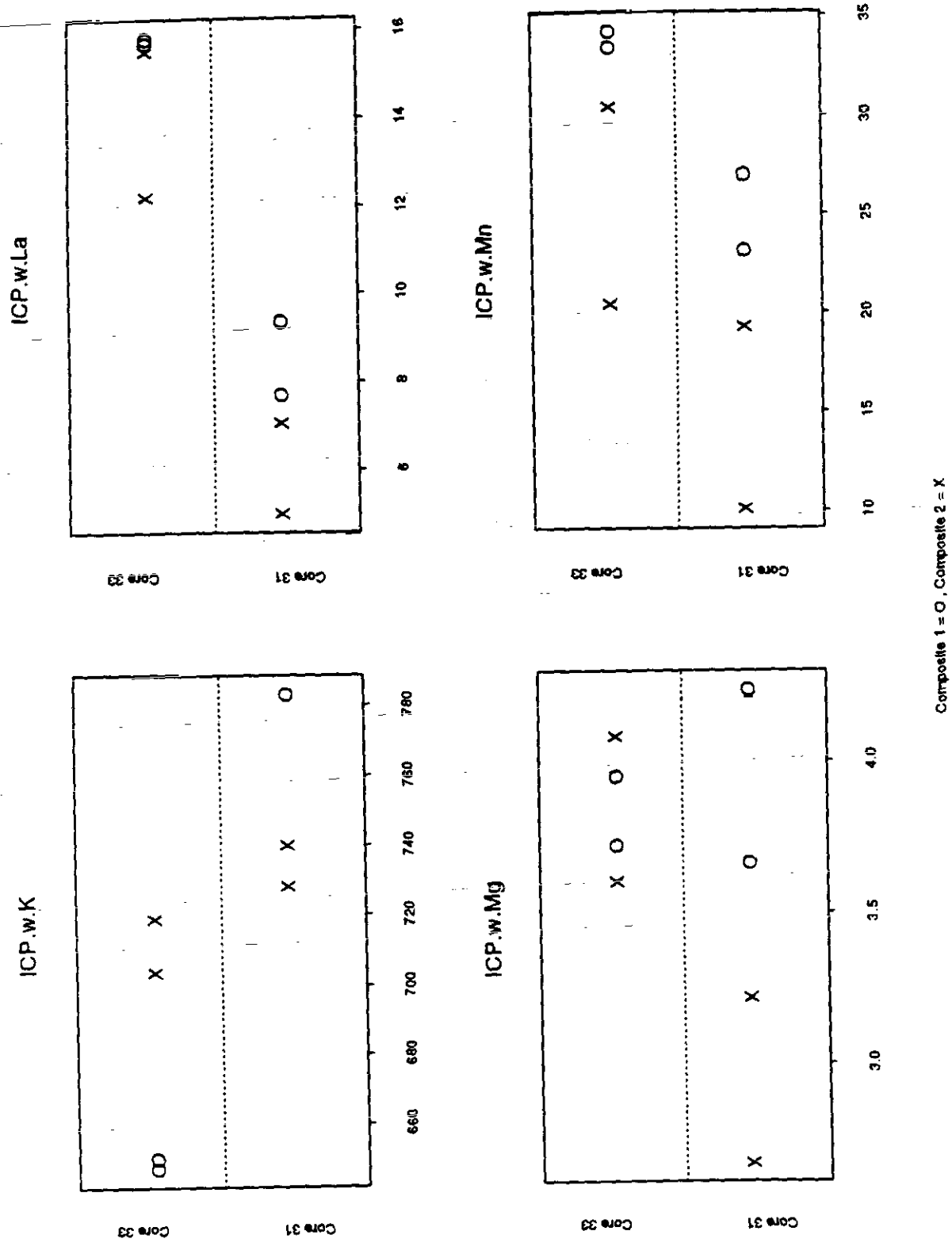

ICP.f.La
3400
3600
3800
4000
4200
4400
4600
4800
Core 31
Core 33
ICP.f.Mn
6000
6200
6400
6600
Core 31
Core 33
ICP.f.Fe
16000
17000
18000
19000
20000
21000
Core 31
Core 33
ICP.f.Mg
300
350
400
450
Core 31
Core 33
Composite 1 = O , Composite 2 = X

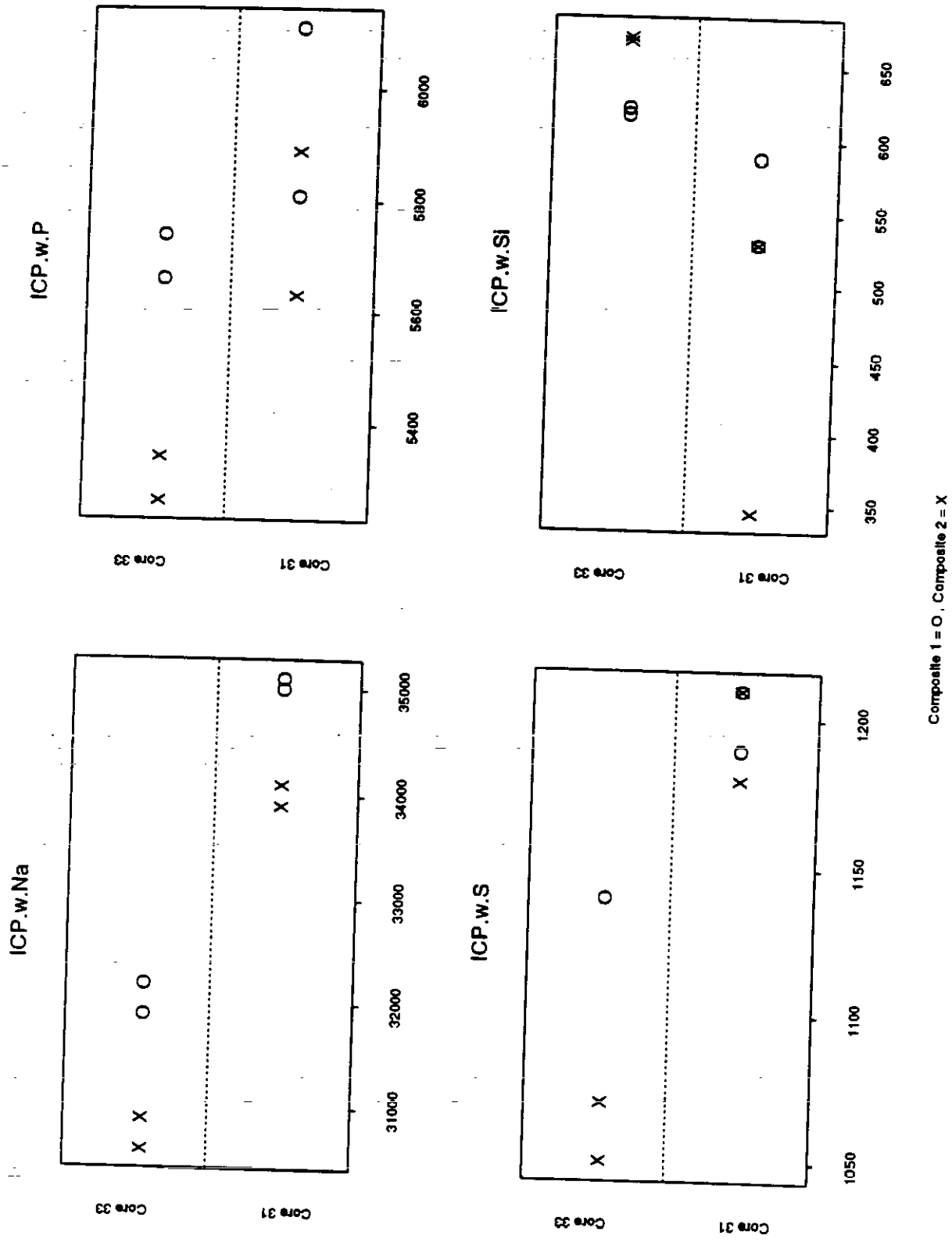

ICP.f.Ni
4000
6000
8000
10000
12000
14000
ICP.f.Pb
300
350
400
450
ICP.f.Na
34000
35000
36000
37000
38000
39000
40000
ICP.f.P
9000
9500
10000
10500
11000
11500
12000
Core 31
Core 33
Composite 1 = O , Composite 2 = X

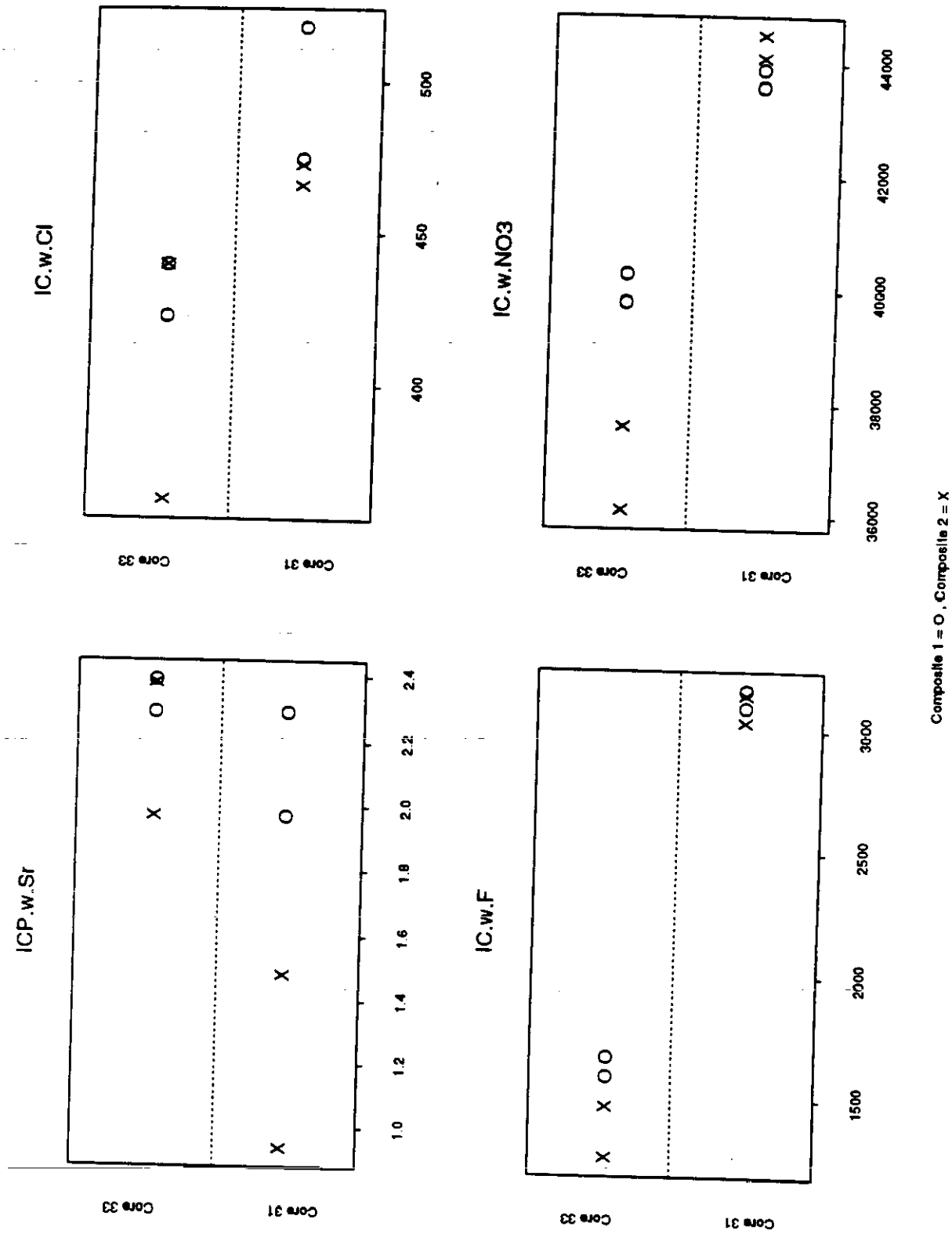

ICP.f.Si
5400
5500
5600
5700
5800
5900
6000
Core 31
Core 33
ICP.f.Ti
30
40
50
60
70
ND
Core 31
Core 33
ICP.f.S
1100
1150
1200
1250
1300
1350
Core 31
Core 33
ICP.f.Sr
280
300
320
Core 31
Core 33
Composite 1 = O , Composite 2 = X

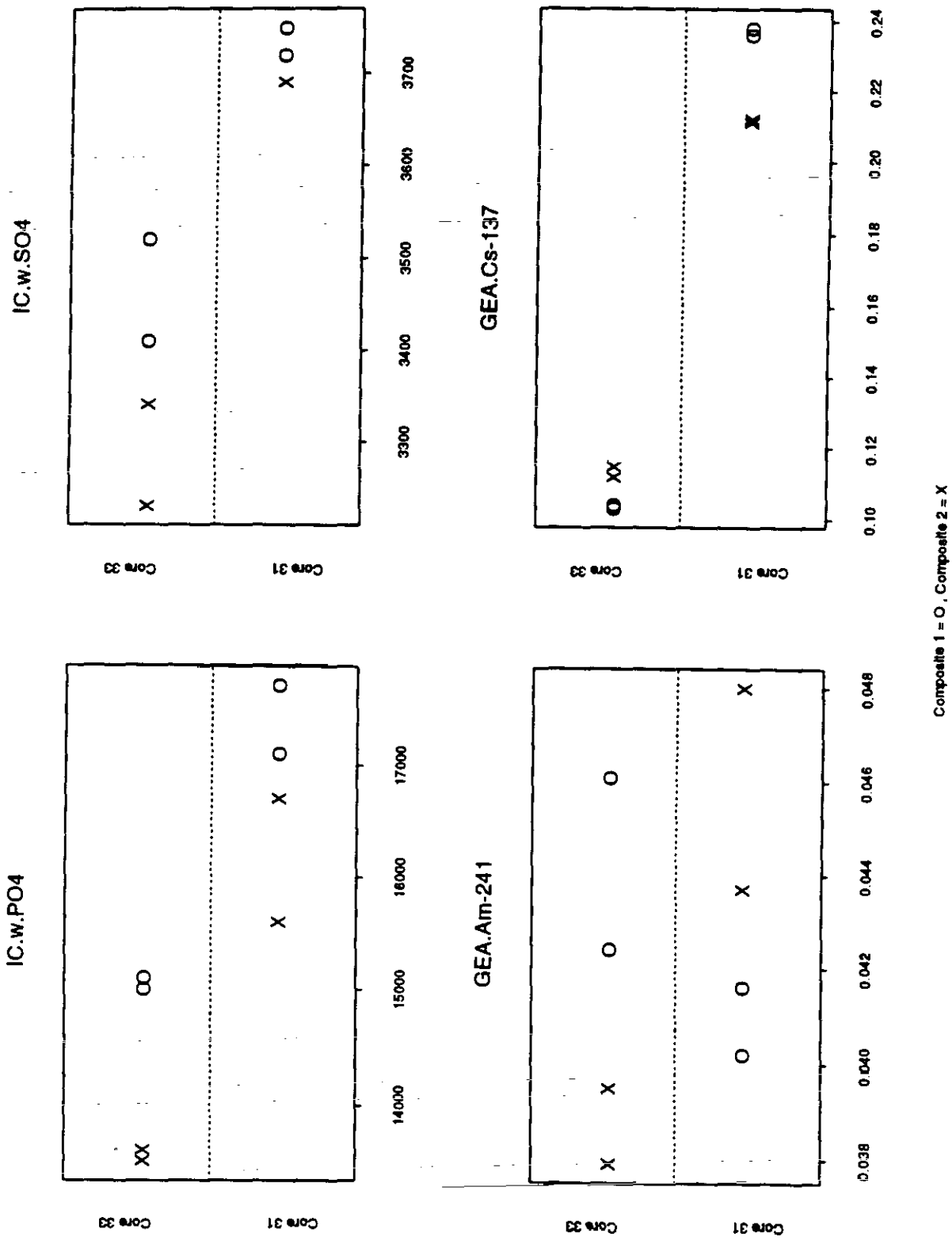

ICP.f.Zn
ICP.w.B
ICP.f.V
ICP.w.Al
Core 31
Core 33
Composite 1 = O, Composite 2 = X

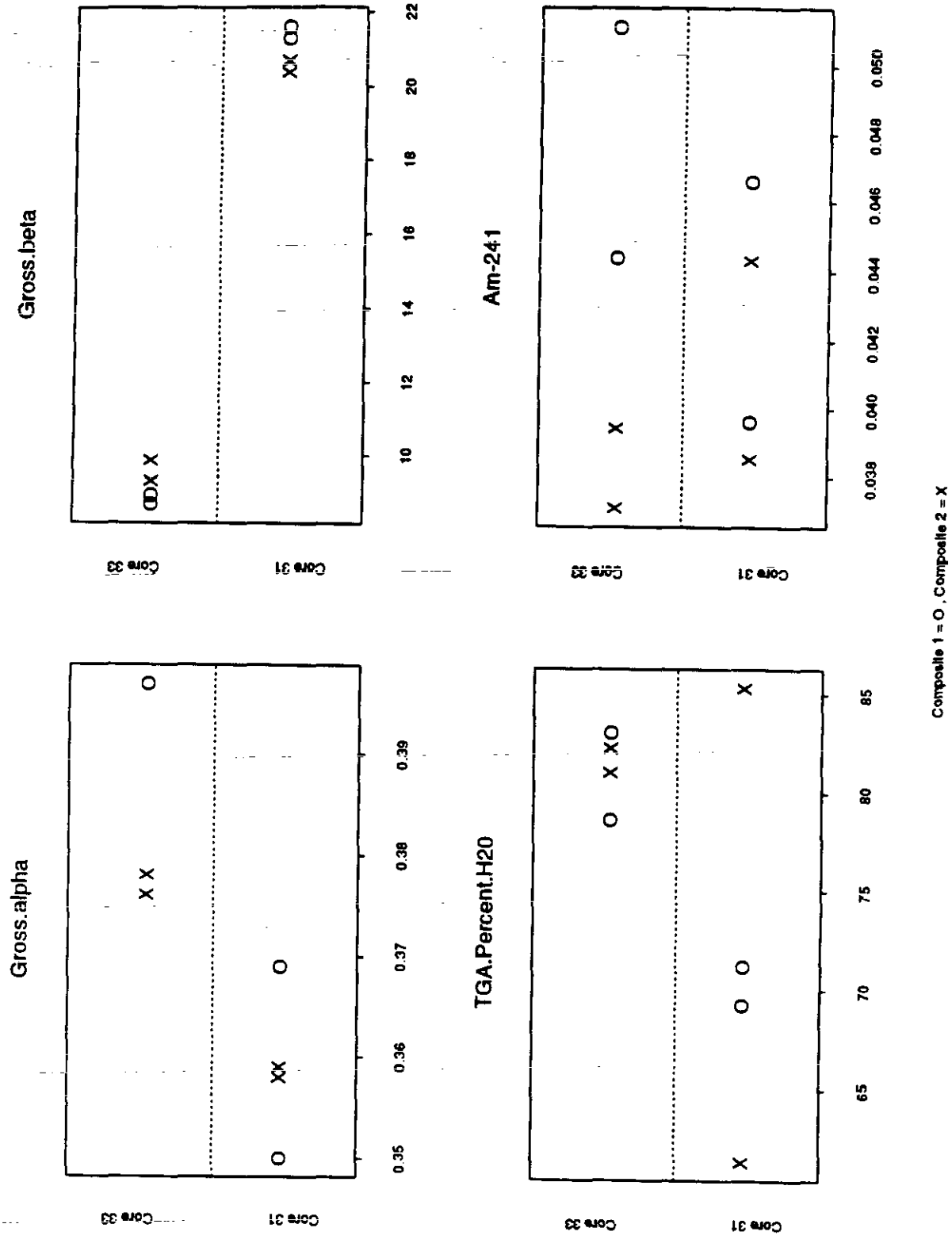

ICP.w.Ca
ICP.w.Fe
ICP.w.Bi
ICP.w.Cr
Core 31
Core 33
Composite 1 = O , Composite 2 = X

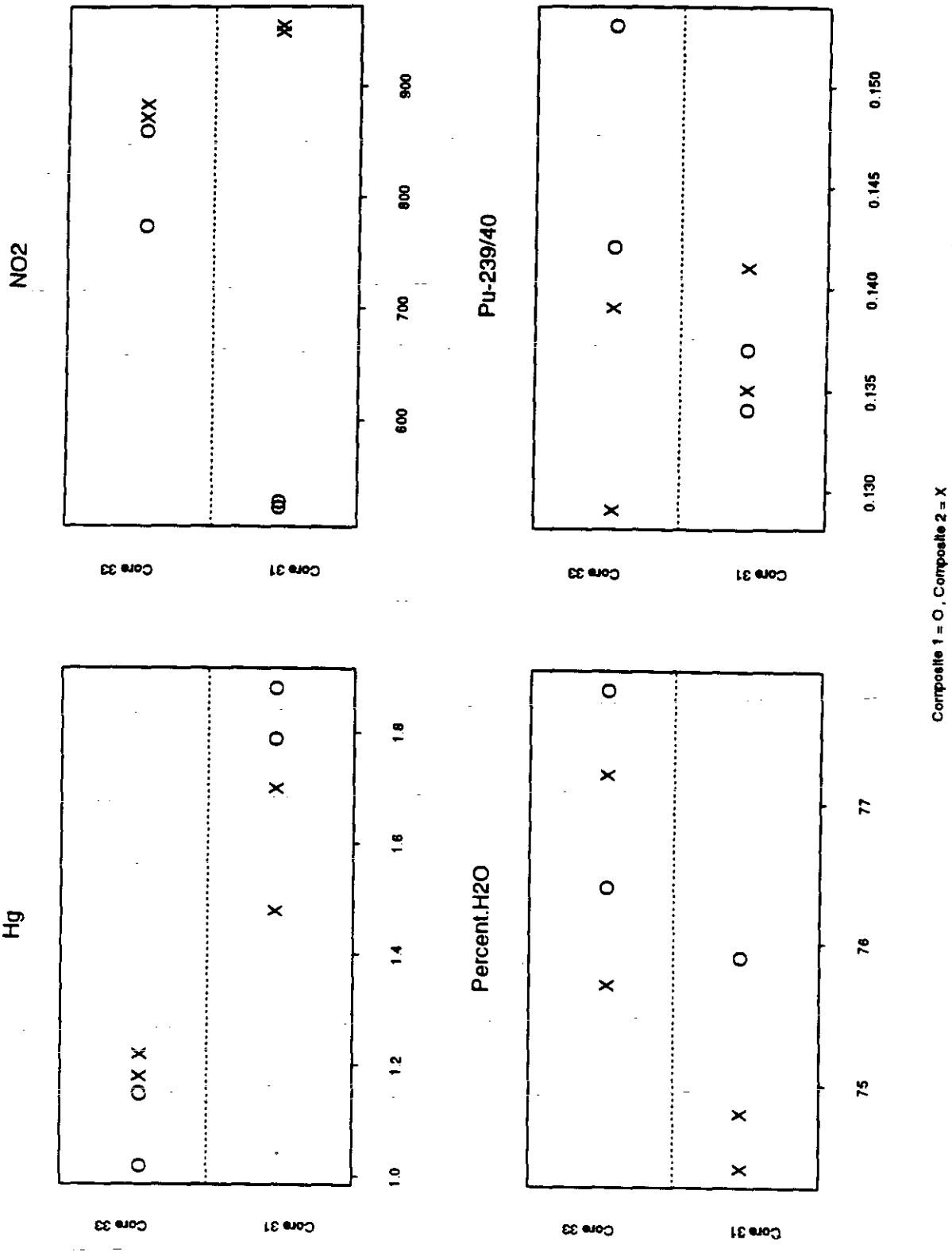

ICP.w.La
ICP.w.Mn
ICP.w.K
ICP.w.Mg
Core 31
Core 33
Composite 1 = O , Composite 2 = X

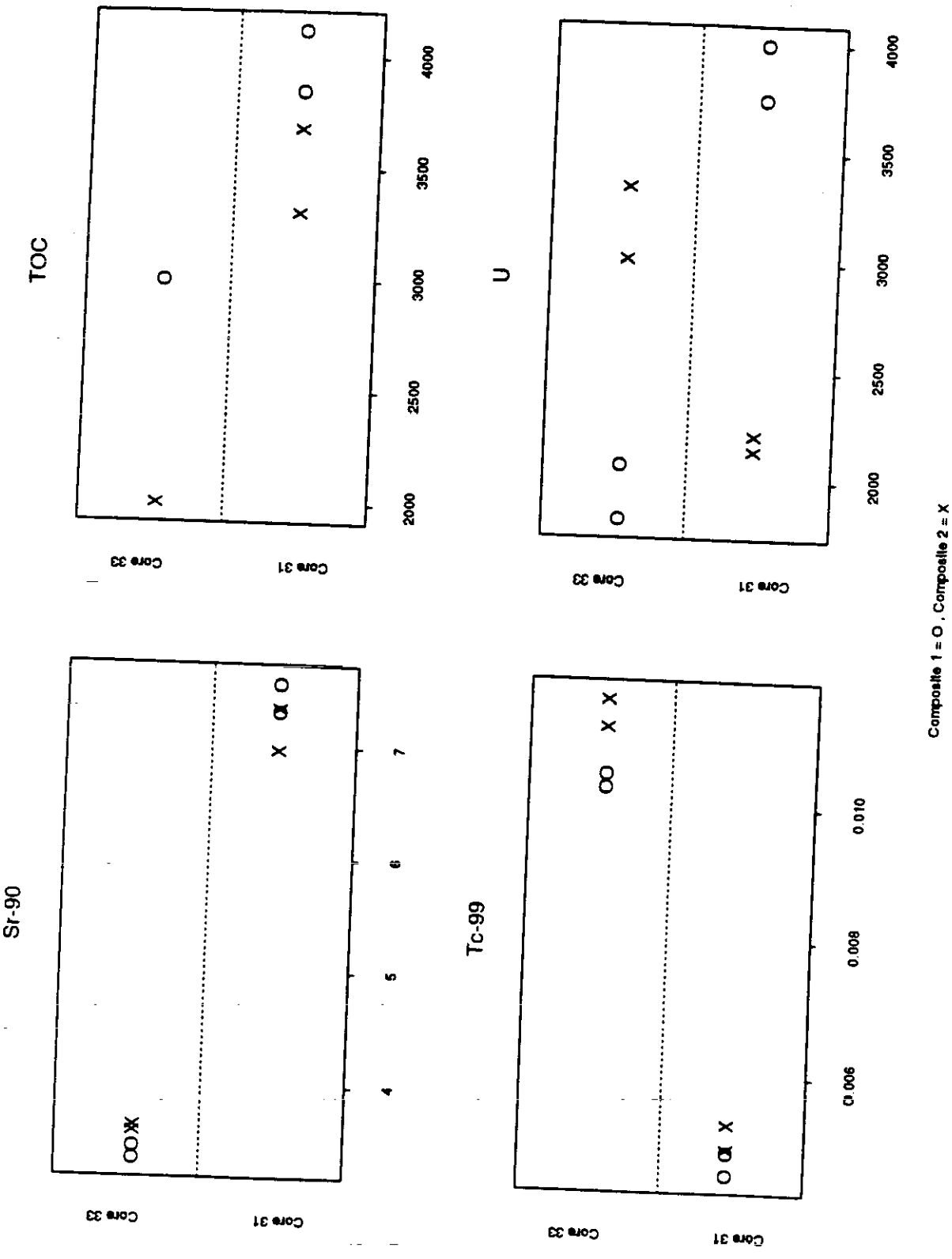

ICP.w.P
ICP.w.Si
ICP.w.Na
ICP.w.S
Core 31
Core 33
Composite 1 = O, Composite 2 = X

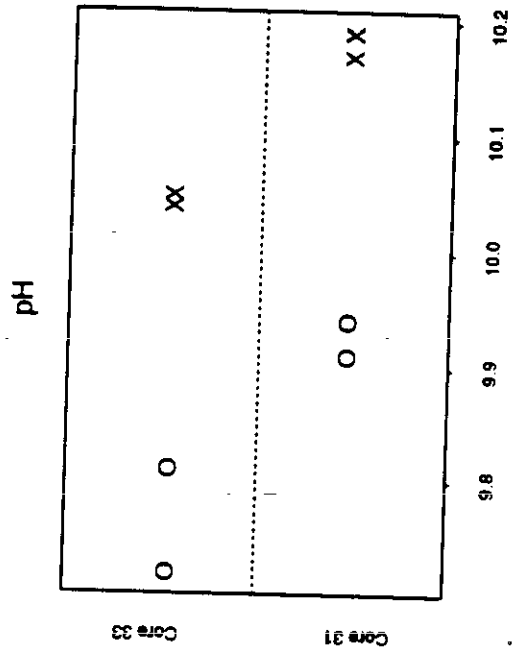

IC.w.Cl
400
450
500
Core 31
Core 33
IC.w.NO3
36000
38000
40000
42000
44000
Core 31
Core 33
ICP.w.Sr
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
Core 31
Core 33
IC.w.F
1500
2000
2500
3000
Core 31
Core 33
Composite 1 = O , Composite 2 = X


IC.w.SO4
3300
3400
3500
3600
3700
GEA.Cs-137
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
IC.w.PO4
14000
15000
16000
17000
GEA.Am-241
0.038
0.040
0.042
0.044
0.046
0.048
Core 31
Core 33
Composite 1 = O ; Composite 2 = X


Gross.beta
Am-241
Gross.alpha
TGA.Percent.H20
Core 31
Core 33
Composite 1 = O , Composite 2 = X


NO2
Pu-239/40
Hg
Percent.H2O
Core 31
Core 33
600
700
800
900
0.130
0.135
0.140
0.145
0.150
1.0
1.2
1.4
1.6
1.8
75
76
77
Composite 1 = O, Composite 2 = X


TOC
U
Sr-90
Tc-99
Core 31
Core 33
2000
2500
3000
3500
4000
4
5
6
7
0.006
0.008
0.010
Composite 1 = O , Composite 2 = X



Composite 1 = O, Composite 2 = X

APPENDIX C

MEAN CONCENTRATION CALCULATION METHODS

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This appendix includes a description of the statistical model that describes the structure of the data from core samples taken from Tank 241-T-111. Equations are also presented for estimates of the mean concentration, the variance for the mean concentration, and the CI on the mean concentration.

The statistical model that describes the structure of the core composite data is

$$y_{ijk} = \mu + S_i + C_{ij} + A_{ijk},\ i = 1, \ldots a,\ j = 1, \ldots b_i,\ k = 1, \ldots n_{ij}, \qquad (1)$$

where

- y_{ijk} = laboratory results from the k^{th} duplicate of the j^{th} composite of the i^{th} core from the tank,
- μ = the grand mean,
- S_i = the effect of the i^{th} core (spatial effect),
- C_{ij} = the effect of the j^{th} composite sample from the i^{th} core,
- A_{ijk} = the analytical error associated with the k^{th} duplicate in the j^{th} composite from the i^{th} core,
- a = the number of cores,
- b_i = the number of composite samples in the i^{th} core and
- n_{ij} = the number of analytical results from the j^{th} composite sample in the i^{th} core.

For cores 31 and 33 there are two core composite samples (i.e., $b_i = 2$).

The variables S_i and C_{ij} are treated as random effects. It is assumed that S_i, C_{ij} and A_{ijk} are each distributed normally with mean zero and variances $\sigma^2(S)$, $\sigma^2(C)$ and $\sigma^2(A)$, respectively. Estimates of $\sigma^2(S)$, $\sigma^2(C)$ and $\sigma^2(A)$ were obtained using Restricted Maximum Likelihood Estimation (REML). This method applied to variance component estimation is described by Harville (1977).

The mean concentration of each analyte of interest in the tank was calculated using the following equation:

$$\bar{y} = \frac{1}{a}\sum_{i=1}^{a}\bar{y}_{i\leftrightarrow} = \frac{1}{a}\sum_{i=1}^{a}\frac{\sum_{j=1}^{b_i}\sum_{k=1}^{n_{ij}} y_{ijk}}{n_{i+}} = \frac{1}{a}\sum_{i=1}^{a}\frac{\sum_{j=1}^{b_i}\sum_{k=1}^{n_{ij}}(\mu + S_i + C_{ij} + A_{ijk})}{n_{i+}}. \quad (2)$$

where

$$\bar{y}_{i\leftrightarrow} = \frac{\sum_{j=1}^{b_i}\sum_{k=1}^{n_{ij}} y_{ijk}}{n_{i+}} \quad \text{and} \quad n_{i+} = \sum_{j=1}^{b_i} n_{ij}. \quad (3)$$

This mean gives the results from each core the same weight regardless of the unbalance that may exist for a particular analyte.

The variance of $\bar{y}$ is

$$V(\bar{y}) = C_1\sigma^2(S) + C_2\sigma^2(C) + C_3\sigma^2(A) \quad (4)$$

where

$$C_1 = \frac{1}{a}, \quad C_2 = \frac{1}{a^2}\sum_{i=1}^{a}\left[\frac{1}{n_{i+}}\right]^2\left[\sum_{j=1}^{b_i} n_{ij}^2\right], \quad C_3 = \frac{1}{a^2}\sum_{i=1}^{a}\left[\frac{1}{n_{i+}}\right]. \quad (5)$$

Using $\hat{\sigma}^2(S)$, $\hat{\sigma}^2(C)$, and $\hat{\sigma}^2(A)$ (REML variance component estimates), an estimated variance of $\bar{y}$ is

$$\hat{\sigma}^2(\bar{y}) = C_1\hat{\sigma}^2(S) + C_2\hat{\sigma}^2(C) + C_3\hat{\sigma}^2(A). \quad (6)$$

The approximate degrees of freedom used for $\hat{\sigma}^2(\bar{y})$ is the number of cores with data minus one.

The lower and upper 95% CI limits (95% LL and 95% UL respectively) on the mean concentration are

$$95\%\ LL = \bar{y} - t_{.975}\sqrt{\hat{\sigma}^2(\bar{y})} \quad \text{and} \quad 95\%\ UL = \bar{y} + t_{.975}\sqrt{\hat{\sigma}^2(\bar{y})} \quad (7)$$

where $t_{.975}$ is the 0.975 quantile from a Student's t-distribution with the approximate degrees of freedom associated with $\hat{\sigma}^2(\bar{y})$.

Appendix C: Calculation and Miscellaneous Data

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ESTIMATED WASTE TANK INVENTORIES -- TOTAL 1 ST QUARTER, 1981

COMPONENT	TANK T-108 MOLES	TANK T-108 CURIES	TANK T-109 MOLES	TANK T-109 CURIES	TANK T-110 MOLES	TANK T-110 CURIES	TANK T-111 MOLES	TANK T-111 CURIES	TANK T-112 MOLES	TANK T-112 CURIES	TANK T-201 MOLES	TANK T-201 CURIES	TANK T-202 MOLES	TANK T-202 CURIES
Ac225	5.E-18	8.E-09	5.E-18	8.E-09	1.E-18	2.E-11	3.E-18	4.E-11	4.E-18	8.E-11	0.	0.	7.E-22	9.E-15
Ac227	8.E-11	1.E-06	5.E-10	8.E-06	2.E-10	3.E-06	4.E-10	8.E-06	1.E-09	2.E-05	0.	0.	4.E-17	8.E-13
Am241	2.E-04	2.E-01	3.E-05	2.E-02	8.E-03	7.E+00	2.E-02	2.E+01	4.E-02	3.E+01	0.	0.	6.E-05	5.E-02
Am242	1.E-14	2.E-08	1.E-15	3.E-07	4.E-14	8.E-06	1.E-11	2.E-03	2.E-12	3.E-04	0.	0.	0.	0.
Am242m	8.E-10	2.E-06	1.E-10	3.E-07	4.E-08	8.E-06	8.E-07	2.E-03	1.E-07	3.E-04	0.	0.	0.	0.
Am243	1.E-07	5.E-06	1.E-08	8.E-07	5.E-07	2.E-05	3.E-06	1.E-04	1.E-05	5.E-04	0.	0.	0.	0.
Al217	2.E-23	8.E-09	2.E-23	8.E-09	5.E-26	2.E-11	1.E-25	4.E-11	2.E-25	8.E-11	0.	0.	2.E-29	8.E-15
Ba137m	2.E-08	1.E+03	8.E-08	8.E+03	4.E-18	3.E-07	0.	0.	0.	0.	0.	0.	0.	0.
Bi210	2.E-18	4.E-12	7.E-20	2.E-12	4.E-19	1.E-11	8.E-19	1.E-11	4.E-18	9.E-11	0.	0.	8.E-22	2.E-14
Bi211	2.E-17	1.E-06	8.E-17	8.E-06	3.E-17	3.E-06	7.E-17	8.E-06	2.E-16	2.E-05	0.	0.	7.E-24	8.E-13
Bi213	2.E-18	8.E-09	1.E-18	8.E-09	4.E-21	2.E-11	1.E-20	4.E-11	1.E-20	8.E-11	0.	0.	2.E-24	8.E-15
Bi214	2.E-21	2.E-11	8.E-22	8.E-12	5.E-21	4.E-11	8.E-21	7.E-11	5.E-20	5.E-10	0.	0.	1.E-23	1.E-13
C14	2.E-03	1.E-01	2.E-03	1.E-01	3.E-14	2.E-12	0.	0.	8.E-39	4.E-37	0.	0.	0.	0.
Cm242	2.E-12	2.E-06	3.E-13	2.E-07	8.E-12	7.E-06	2.E-08	2.E-03	4.E-10	3.E-04	0.	0.	0.	0.
Cm244	7.E-08	1.E-04	1.E-08	2.E-05	4.E-20	8.E-18	0.	0.	7.E-38	1.E-33	0.	0.	0.	0.
Cm245	5.E-11	2.E-08	7.E-12	3.E-10	8.E-22	4.E-20	0.	0.	0.	0.	0.	0.	0.	0.
Cs135	4.E-02	7.E-03	8.E-01	1.E-01	1.E-11	2.E-12	0.	0.	8.E-37	1.E-37	0.	0.	0.	0.
Cs137	1.E-01	2.E+03	8.E-01	7.E+03	2.E-11	3.E-07	0.	0.	1.E-35	1.E-31	0.	0.	0.	0.
Fr221	2.E-18	8.E-09	2.E-18	8.E-08	4.E-22	2.E-11	1.E-21	4.E-11	1.E-21	8.E-11	0.	0.	2.E-25	8.E-15
Fr223	2.E-18	2.E-06	1.E-17	1.E-07	4.E-18	4.E-08	1.E-17	9.E-08	3.E-17	3.E-07	0.	0.	1.E-24	8.E-15
I129	2.E-02	5.E-04	1.E-01	3.E-03	4.E-12	8.E-14	0.	0.	4.E-37	9.E-39	0.	0.	0.	0.
Nb93m	7.E-08	2.E-01	1.E-08	4.E-02	8.E-08	2.E-01	8.E-08	2.E-01	1.E-05	3.E-01	0.	0.	0.	0.
Ni63	8.E-04	3.E+00	6.E-03	2.E+01	1.E-14	5.E-11	2.E-04	8.E-01	2.E-03	9.E+00	0.	0.	0.	0.
Np237	1.E-02	2.E-03	4.E-02	7.E-03	3.E-04	5.E-05	5.E-04	9.E-05	1.E-03	2.E-04	0.	0.	2.E-08	3.E-07
Np239	8.E-14	5.E-08	1.E-14	8.E-07	4.E-13	2.E-05	2.E-12	1.E-04	8.E-12	5.E-04	0.	0.	0.	0.
Pa231	3.E-07	4.E-06	1.E-06	1.E-05	8.E-07	7.E-06	2.E-06	2.E-05	5.E-06	5.E-05	0.	0.	2.E-13	2.E-12
Pa233	4.E-10	2.E-03	1.E-08	7.E-03	1.E-11	5.E-05	2.E-11	8.E-05	3.E-11	2.E-04	0.	0.	5.E-14	3.E-07
Pa234m	8.E-13	1.E-01	2.E-13	4.E-02	1.E-12	2.E-01	4.E-12	8.E-01	1.E-11	2.E+00	0.	0.	0.	0.
Pb209	8.E-18	8.E-09	8.E-18	8.E-08	2.E-20	2.E-11	5.E-20	4.E-11	8.E-20	8.E-11	0.	0.	8.E-24	8.E-15
Pb210	2.E-16	4.E-12	1.E-16	2.E-12	8.E-16	8.E-12	8.E-16	1.E-11	5.E-15	8.E-11	0.	0.	1.E-18	2.E-14
Pb211	3.E-18	1.E-08	2.E-15	8.E-08	5.E-16	3.E-06	1.E-15	8.E-06	4.E-15	2.E-05	0.	0.	1.E-22	8.E-13
Pb214	2.E-21	2.E-11	8.E-22	8.E-12	8.E-21	5.E-11	1.E-20	7.E-11	7.E-20	5.E-10	0.	0.	2.E-23	1.E-13
Pd107	1.E-02	7.E-04	5.E-02	3.E-03	2.E-12	1.E-13	0.	0.	2.E-37	1.E-38	0.	0.	0.	0.
Po210	4.E-18	4.E-12	2.E-18	2.E-12	8.E-18	8.E-12	1.E-17	1.E-11	8.E-17	8.E-11	0.	0.	2.E-20	2.E-14
Po213	2.E-27	8.E-08	2.E-27	8.E-08	8.E-30	2.E-11	2.E-29	4.E-11	2.E-28	5.E-11	0.	0.	3.E-33	8.E-15

ASSUMPTIONS USED IN THIS MODEL ARE STATED AT END OF REPORT

ESTIMATED WASTE TANK INVENTORIES -- TOTAL 1 ST QUARTER, 1981 -- CONTINUED

COMPONENT	TANK T-108 MOLES	TANK T-108 CURIES	TANK T-109 MOLES	TANK T-109 CURIES	TANK T-110 MOLES	TANK T-110 CURIES	TANK T-111 MOLES	TANK T-111 CURIES	TANK T-112 MOLES	TANK T-112 CURIES	TANK T-201 MOLES	TANK T-201 CURIES	TANK T-202 MOLES	TANK T-202 CURIES
Po214	3 E-28	2 E-11	1 E-28	8 E-12	8 E-28	6 E-11	1 E-27	9 E-11	9 E-27	6 E-10	0.	0.	2 E-30	1 E-13
Po215	2 E-22	1 E-06	1 E-21	8 E-06	4 E-22	3 E-06	1 E-21	6 E-06	3 E-21	2 E-05	0.	0.	1 E-28	6 E-13
Po218	2 E-22	2 E-11	1 E-22	6 E-12	7 E-22	5 E-11	1 E-21	7 E-11	8 E-21	5 E-10	0.	0.	2 E-24	1 E-13
Pu238	2 E-06	8 E-03	4 E-07	2 E-03	1 E-04	4 E-01	2 E-04	7 E-01	3 E-03	1 E+01	0.	0.	5 E-07	2 E-03
Pu239	3 E-01	5 E+00	3 E-02	5 E-01	1 E+01	2 E+02	8 E+00	1 E+02	1 E+01	2 E+02	0.	0.	2 E-02	3 E-01
Pu240	6 E-03	4 E-01	7 E-04	4 E-02	3 E-01	2 E+01	4 E-01	2 E+01	7 E-01	4 E+01	0.	0.	1 E-03	6 E-02
Pu241	3 E-05	8 E-01	3 E-06	9 E-02	3 E-03	8 E+01	8 E-03	2 E+02	1 E-02	4 E+02	0.	0.	2 E-05	5 E-01
Ra223	1 E-13	1 E-06	7 E-13	8 E-06	2 E-13	3 E-06	8 E-13	6 E-06	2 E-12	2 E-05	0.	0.	5 E-20	8 E-13
Ra225	7 E-16	6 E-09	7 E-16	6 E-09	2 E-18	2 E-11	5 E-18	4 E-11	6 E-18	6 E-11	0.	0.	1 E-21	9 E-15
Ra226	7 E-14	2 E-11	3 E-14	6 E-12	2 E-13	5 E-11	3 E-13	7 E-11	2 E-12	5 E-10	0.	0.	5 E-16	1 E-13
Ru106	5 E-10	2 E-04	5 E-11	2 E-05	3 E-11	1 E-05	1 E-10	4 E-05	9 E-10	3 E-04	0.	0.	0.	0.
Sb126	3 E-09	3 E-02	3 E-10	3 E-03	4 E-09	4 E-02	4 E-09	4 E-02	5 E-09	6 E-02	0.	0.	0.	0.
Sb126m	3 E-12	3 E-02	4 E-13	3 E-03	4 E-12	4 E-02	4 E-12	4 E-02	6 E-12	6 E-02	0.	0.	0.	0.
Se79	2 E-03	9 E-03	1 E-02	5 E-02	5 E-13	3 E-12	0.	0.	5 E-38	3 E-37	0.	0.	0.	0.
Sm151	2 E-02	1 E+02	3 E-03	1 E+01	3 E-02	1 E+02	2 E-02	6 E+01	2 E-02	8 E+01	0.	0.	0.	0.
Sn126	9 E-03	3 E-02	1 E-03	3 E-03	1 E-02	4 E-02	1 E-02	4 E-02	2 E-02	6 E-02	0.	0.	0.	0.
Sr90	4 E-01	4 E+03	7 E-03	9 E+01	4 E-01	4 E+03	3 E-01	4 E+03	5 E-01	6 E+03	0.	0.	0.	0.
Tc99	2 E-01	3 E-01	1 E+00	2 E+00	6 E-11	1 E-10	0.	0.	3 E-36	5 E-36	0.	0.	0.	0.
Th227	2 E-13	1 E-06	1 E-12	8 E-06	4 E-13	3 E-06	9 E-13	6 E-06	3 E-12	2 E-05	0.	0.	8 E-20	6 E-13
Th229	1 E-10	6 E-09	1 E-10	6 E-09	3 E-13	2 E-11	9 E-13	4 E-11	1 E-12	6 E-11	0.	0.	2 E-16	9 E-15
Th230	5 E-10	2 E-09	2 E-10	8 E-10	2 E-09	1 E-08	4 E-09	2 E-08	3 E-08	1 E-07	0.	0.	6 E-12	3 E-11
Th231	5 E-11	6 E-03	1 E-11	2 E-03	8 E-11	1 E-02	2 E-10	3 E-02	7 E-10	9 E-02	0.	0.	6 E-17	8 E-09
Th234	2 E-08	1 E-01	7 E-09	4 E-02	4 E-08	2 E-01	1 E-07	6 E-01	4 E-07	2 E+00	0.	0.	0.	0.
Tl207	3 E-17	1 E-06	2 E-16	8 E-06	7 E-17	3 E-06	2 E-16	6 E-06	5 E-16	2 E-05	0.	0.	2 E-23	6 E-13
U233	2 E-06	4 E-06	2 E-06	4 E-06	3 E-09	7 E-09	8 E-09	2 E-08	1 E-08	3 E-08	0.	0.	5 E-12	1 E-11
U234	9 E-06	1 E-05	3 E-06	4 E-06	5 E-05	7 E-05	8 E-05	1 E-04	7 E-04	1 E-03	0.	0.	1 E-07	2 E-07
U235	1 E+01	6 E-03	3 E+00	2 E-03	2 E+01	1 E-02	5 E+01	3 E-02	2 E+02	9 E-02	0.	0.	2 E-05	8 E-09
U238	2 E+03	1 E-01	5 E+02	4 E-02	3 E+03	2 E-01	8 E+03	6 E-01	3 E+04	2 E+00	0.	0.	0.	0.
Y90	9 E-05	4 E+03	2 E-06	9 E+01	9 E-05	5 E+03	8 E-05	4 E+03	1 E-04	6 E+03	0.	0.	0.	0.
Zr93	9 E-01	2 E-01	1 E-01	2 E-02	1 E+00	3 E-01	1 E+00	3 E-01	1 E+00	3 E-01	0.	0.	0.	0.
Ag	2 E-08	0.	2 E-07	0.	2 E-17	0.	0.	0.	0.	0.	0.	0.	0.	0.
Al	1 E+03	0.	2 E+04	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Ba	3 E+00	0.	2 E+00	0.	2 E-03	0.	0.	0.	6 E-03	0.	0.	0.	0.	0.
Bi	7 E+03	0.	8 E+02	0.	1 E+07	0.	1 E+07	0.	1 E+07	0.	0.	0.	3 E+02	0.
C2H3O3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

ASSUMPTIONS USED IN THIS MODEL ARE STATED AT END OF REPORT

ESTIMATED WASTE TANK INVENTORIES -- TOTAL 1 ST QUARTER, 1981 -- CONTINUED

COMPONENT	TANK T-108 MOLES	TANK T-108 CURIES	TANK T-109 MOLES	TANK T-109 CURIES	TANK T-110 MOLES	TANK T-110 CURIES	TANK T-111 MOLES	TANK T-111 CURIES	TANK T-112 MOLES	TANK T-112 CURIES	TANK T-201 MOLES	TANK T-201 CURIES	TANK T-202 MOLES	TANK T-202 CURIES
C6H5O7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CO3	1.E+04	0.	3.E+05	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Ca	6.E-33	0.	6.E-34	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Ce	5.E-01	0.	2.E+01	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Cl	4.E-06	0.	1.E-04	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Cr	1.E+03	0.	1.E+02	0.	2.E+04	0.	3.E+04	0.	3.E+04	0.	0.	0.	2.E+02	0.
EDTA	0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
F	3.E+04	0	1.E+04	0	8.E+03	0.	3.E+03	0.	3.E+03	0.	0.	0.	2.E+04	0.
Fe	2.E+04	0.	2.E+03	0.	4.E+05	0.	4.E+05	0.	5.E+05	0.	0.	0.	0.	0.
Fe(CN)6	3.E+01	0.	3.E+00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HEDTA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
K	3.E+02	0.	3.E+01	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.E+04	0.
La	0	0.	0.	0.	0.	0.	8.E+03	0.	8.E+02	0.	0.	0.	1.E+02	0.
Mn	0	0.	0	0.	0.	0.	2.E+04	0.	2.E+03	0.	0.	0.	3.E+02	0.
NO2	3.E+02	0.	2.E+04	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NO3	2.E+04	0	3.E+05	0	3.E+04	0.	0.	0.	4.E-28	0.	0.	0.	1.E+05	0.
Na	4.E+05	0.	1.E+06	0.	8.E+04	0.	0.	0.	5.E-07	0.	1.E+01	0.	2.E+05	0.
Ni	6.E-03	0.	6.E-04	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OH	6.E+04	0.	8.E+03	0.	1.E+06	0.	2.E+06	0.	2.E+06	0.	1.E+01	0.	5.E+04	0.
PO4	1.E+05	0.	5.E+04	0.	1.E+07	0.	1.E+07	0.	1.E+07	0.	0.	0.	3.E+03	0.
Pb	4.E-11	0.	3.E-10	0.	6.E-11	0.	1.E-10	0.	4.E-10	0.	0.	0.	9.E-18	0.
SiO3	7.E+01	0.	4.E+03	0.	2.E-05	0.	0.	0.	6.E-30	0.	0.	0.	0.	0.
SO4	3.E+03	0.	8.E+04	0.	2.E-03	0.	0.	0.	6.E-03	0.	0.	0.	3.E+02	0.
Sr	0	0.	0	0.	0	0.	0.	0.	0	0.	0.	0.	0.	0.
ZrO	2.E+03	0.	3.E+02	0.	4.E-01	0.	3.E-01	0.	4.E-01	0.	0.	0.	0.	0.

ASSUMPTIONS USED IN THIS MODEL ARE STATED AT END OF REPORT

WHC ENVIRONMENTAL INDUSTRIAL HYGIENE FIELD MONITORING

Page 1 of 2

1. Work Package No.: ZW-94-00244-W
2. Contact: BUTCH HALL
3. Building/Facility: 272-WA TANK FARM
4. Area: 2-W
5. Monitoring Date: 3-5-94
6. Room/Location/Site No. T-FARM
7. Monitoring By: Evan D. Clark

8. PPE (Resp. Prot. & Prot. Clothing)	9. Engineering Controls/Work Practices:
RWP-CS-009	ALARA

10. Instrument Type	11. Instrument ID Nos.	12. Calibration Data. (Date, Time)
MX251	9308082-094	3-5-94 0700
OVM580B	37025-255	3-5-94 0700
—	—	—

13. Monitoring Type	14. Time	15. Location	16. Activity	17. Results
O2	0940	111-T	SUPERNATANT SAMPLES	20.9%
LEL	1	111-T	SUPERNATANT SAMPLES	0.0 %
ORGANICS	1040	111-T	SUPERNATANT SAMPLES	*9.2 PPM
ORGANICS	0900 - 10:40	111-T	BREATHING ZONE	0.0 PPM
		N/A		

EIH-FIELD MONITORING FORM (REV. 3, 9-26-91)

WHC ENVIRONMENTAL INDUSTRIAL HYGIENE FIELD MONITORING - Continuation Page

Page 2 of 2

13. Monitoring Type (cont.)	14. Time (cont.)	15. Location (cont.)	16. Activity (cont.)	17. Results (cont.)

18. Comments: * ALL WORKER INSIDE 111-T SALTWELL PIT WAS ON SCBA READING DIDN'T EXCEED 9.2 PPM T.O.C., BUT WAS A 3 MINUTE CONTINUOUS H.T.

Westinghouse Hanford Company — **Internal Memo**

From: West Tank Farms Operations
Phone: 372-3919 T4-08
Date: March 3, 1994
Subject: TANK T-111

94-003

To: D. A. Turner R2-78

cc:

H. Babad	R2-78	J. W. Lentsch	-78
D. C. Board	S1-57	D. M. Lucoff	36
V. C. Boyles	R1-49	G. J. Miskho	R2- 2
D. A. Bragg	R1-49	D. J. Newland	R2- 5
R. G. Brown	R2-11	R. Ni	S5-07
R. J. Cash	R2-78	J. W. Osborne	R2-78
G. M. Christensen	H4-21	M. A. Payne	R2-31
C. DeFigh-Price	R2-31	M. Plys	H2-62
A. J. Duckett	HO-39	A. Postma	H4-61
G. T. Dukelow	R2-78	T. E. Rainey	R4-02
J. C. Fulton	R2-31	R. E. Rayond	R2
J. M. Grigsby	H2-62	J. P. Sederburg	R2-
G. A. Hanson	R2-08	M. H. Shannon	H4-
J. O. Honeyman	R2-52	M. J. Sutey	R1-49
M. N. Islam	R2-08	O. S. Wang	R2-78
G. D. Johnson	R2-178	N. W. Kirch	R2-11
R. D. Wojtasek	R2-36	J. L. Lee	R2-36
JHW File/LB			

MAR 9 1994
N. W. Kirch

References: (1) Internal Memo, Organic Tank Safety to J. H. Wicks, et al., "Tank T-111" dated February 28, 1994

In accordance with your recommendation in reference 1, Tank T-111 has been placed on the organics tanks Watch List. Operational Specifications for Watch List Tanks (OSD-T-151-00030) has been changed to add tank T-111 to the Organic Salt List in Appendix A. Notification of this change was included in the Daily Operating Report (DOR) on 3/3/94.

If you have any questions, please call David P. Reber (373-5385).

J. H. Wicks, Manager
West Tank Farm Operations

Westinghouse Hanford Company

Internal Memo

From: Organic Tank Safety
Phone: 373-2238 R2-78
Date: February 28, 1994
Subject: TANK T-111

7A700-94.004

To: J. H. Wicks

cc:

H. Babad	R2-78	J. W. Lentsch	R2-78
D. C. Board	S1-57	D. M. Lucoff	N1-36
V. C. Boyles	R1-49	G. J. Miskho	R2-12
D. A. Bragg	R1-49	D. J. Newland	R2-36
R. G. Brown	R2-11	R. Ni	S5-07
R. J. Cash	R2-78	J. W. Osborne	R2-78
G. M. Christensen	H4-21	M. A. Payne	R2-31
C. DeFigh-Price	R2-31	M. Plys	H2-62
A. J. Duckett	H0-30	A. Postma	H4-61
G. T. Dukelow	R2-78	T. E. Rainey	R4-02
J. C. Fulton	R2-31	R. E. Raymond	R2-54
J. M. Grigsby	H2-62	J. P. Sederburg	R2-11
G. A. Hanson	R2-08	M. H. Shannon	H4-61
J. O. Honeyman	R2-52	M. J. Sutey	R1-49
M. N. Islam	R2-08	O. S. Wang	R2-78
G. D. Johnson	R2-78	J. H. Wicks	T4-07
N. W. Kirch	R2-11	R. D. Wojtasek	R2-36
J. L. Lee	R2-36	DAT File/LB	

References:

(1) Internal Memo, D. A. Turner to H. Babad, et al., "Reactive Component in Tank 241-T-111," dated January 17, 1994.

(2) PNL Memo, D. L. Baldwin to R. M. Bean, et al., "T-111 Dry/Wet Preliminary TOC Results from Two Methods," dated January 11, 1994.

(3) Letter, S. G. McKinley, PNL, to C. DeFigh-Price, WHC, "Tank T-111, Core 33, Segment 2 Preliminary Data," dated December 20, 1993.

(4) Internal Memo, A. J. Duckett to D. B. Bechtold, et al., "Tank Farms PRC Meeting Minutes for December 1, 1993 - Potential Reactive Component in Tank 241-T-111," dated December 2, 1993.

(5) WHC-EP-0681, UC-600, "Interim Criteria for Organic Watch List Tanks at the Hanford Site," dated September 1993.

Waste Tank Safety Program recommends that tank T-111 be placed on the organic tanks Watch List, effective immediately.

The Tank Farms Plan Review Committee (PRC) made a decision on December 1, 1993, that tank T-111 was to be treated as an organics Watch List tank (Reference 4). This decision was prompted by the fact that portions of tank T-111 core material retrieved in 1991 and analyzed in 1992 exhibited significant exothermic activity in Differential Scanning Calorimetry (DSC) tests. The PRC also recommended that additional analyses be performed on existing samples (Reference 4).

PNL has rerun a number of key analyses on tank T-111 Core 33, Segment 2 samples (References 2 and 3). Reference 1 was issued after review of the PNL analytical results to put the tank T-111 issue into perspective, based on what we know at this time. Two conclusions were reached in Reference 1:

- No imminent safety hazard exists relative to the reactive component identified in tank T-111 waste because of the high (~80 wt.%) moisture content of the waste.
- Additional information on the active component in tank T-111 waste is required. The observed exothermic activity can not be fully accounted for based on reported total organic carbon (TOC) levels.

The recommendation to place tank T-111 on the organics tank Watch List at this time is based on the following rationale:

- Tank T-111 Core 33, Segment 2 sample analyses performed by PNL were conducted on material dried at 60°C under vacuum in an effort to reduce the scatter previously encountered in analytical data.
- PNL analytical results indicate exothermic activity in the dried sample of 215 cal/g (dry basis) from DSC tests (Reference 3). TOC content was determined to be 4.1 wt.% (dry basis) using the Furnace Total Combustion Method on dried sample material (Reference 2). Waste moisture content was confirmed to be approximately 80 wt.% (Reference 3).
- The attachment derives the energy equivalent of a 5 wt.% TOC (dry basis) organic-nitrate/nitrite mixture based on sodium acetate as the organic waste surrogate. 5 wt.% TOC (dry basis) is shown to be equivalent to exothermic activity of 151 cal/g.
- Reference 5 establishes interim criteria for organic Watch List tanks at the Hanford Site. Single-shell tank (SST) waste is to be classified as "conditionally safe" if its organic content exceeds 5 wt.% TOC (dry basis) and its moisture content is $\geq$17 wt. %.

- If, as shown above, 151 cal/g represents the energy equivalent of a 5 wt.% TOC (dry basis) organic-nitrate/nitrite mixture, then the waste in tank T-111 would be classified as "conditionally safe" in view of its 215 cal/g exotherm and 80 wt.% moisture content.

- SSTs with waste classified as "conditionally safe" are to be placed on the organic tanks Watch List (Reference 5).

- Tank T-111 should, therefore, be placed on the organic tanks Watch List.

- It should be noted that PNL's analytical results indicate a TOC content of only 4.1 wt.% (dry basis) (Reference 2). This TOC content, by itself, would not qualify tank T-111 for the Watch List. However, what matters from the standpoint of continued safe interim storage (e.g. safety) is waste energy content (cal/g). Tank T-111 clearly qualifies for the Watch List on this basis.

It appears that tank B-202 exhibits similar characteristics to those of tank T-111. However, it is not the recommendation of the Waste Tank Safety Program to place tank B-202 on the organic tanks Watch List at this time. The preliminary and incomplete analytical data have yet to be confirmed and further evaluation is necessary before making a final decision about tank B-202.

Please call (373-2238) if additional information or discussion would be beneficial.

J. S. Schofield for

D. A. Turner, Manager
Organic Tank Safety

mjs

Attachment

Modeling T-111

A simple model of T-111 was made on the ESP simulation program to attempt to shed some light on the vapor concentration issue. This simple model would mix about 1 liter of aqueous solution similar to T-111 and 1 liter of air. Some NPH type organics were also mixed. The vapor phase leaving the mixture was estimated.

Aqueous solution

The aqueous solution used for this simulation was:

H2O	1000 g
NaNO2	0.54 g
NaNO3	30.7 g
Na2CO3	0.5 g

The model calculated this to be 1.017 liters with a density of 1.026 compared with T-111 liquid density of 1.07.

AIR

One liter of air was introduce assuming only O2 and N2.

The model calculated that there was 1.08 liters of air

Organic

The organic chosen was of the NPH type.

C10H22	0.3 g
C11H24	0.15 g
C12H26	0.05 g

This mixture is just an estimation.

Mixture Conditions

The mixture conditions were 72 °F and 14.7 psia.

Case #1

A total of 0.5 grams of the organic mixture was added to the mixture.

This resulted in the following vapor composition:

Component	Vol %
H2O	2.62 %
O2	18.81%
N2	71.68%
C10H22	4.32%
C11H24	1.97%
C12H26	0.60%

The remainder of the organic was soluble in the liter of aqueous solution. There was no organic phase.

Note that the vapor phase contained large amounts of the hydrocarbons. This is well above what was measured. Several orders of magnitude.

Conclusions:

T-111 does not need a separable phase organic layer to explain the observed vapor pressure of 9 ppm. Dissolved organics in an aqueous phase can explain this.

Had T-111 had a small amount of NPH floating on it, it probably would have evaporated by now. Notice that the C10H22 is very much greater in concentration. This means that over time, the C12H26 would tend to be left behind. This has a smaller vapor pressure and is safer.

Distribution

LR Pederson	K2-44
MG Plys	H4-62
LL Burger	P7-25
RD Scheele	P7-25
GL Borsheim	R2-11
DM Camaioni	K2-38
MH Campbell	R3-77
BC Simpson	R2-12
WD Samuels	K2-44
JA Campbell	P8-08
JP Sederberg	R2-11
H Babad	R2-78

Battelle
Pacific Northwest Laboratories

Project Number

RECEIVED
JAN 2 0 1994
R.M. BEAN

Internal Distribution

JM Tingey
MW Urie
RT Steele
SG McKinley
EW Hoppe
File/LB

Date January 14, 1994

To RM Bean

From DL Baldwin

Subject FINAL T-111 (Core 33, Segment 2) DRY/AS-RECEIVED TOC RESULTS FROM TWO METHODS, Rev. 2.

This is the Final report of results from TOC/TIC/TC measurements of the analyzed "dried" and "as-received" T-111 sample, ALO No. 94-2631, analyzed by two methods, as follows:

1) Hot Persulfate method, in normal TIC/TOC mode, and TC mode,
2) Furnace Total Combustion method, in both TOC mode and TC mode.

The data on the drying of the sample, as performed by JM Tingey, shows the sample to contain 18.4% solids. In this report, no corrections are made for the "dried" samples results.

Description of Methods: Part 1 of this work is done by the hot persulfate oxidation method, Test Procedure PNL-ALO-381, rev. 0, "Determination of TC, TOC, and TIC in Radioactive Liquids, Soils and Sludges by Hot Persulfate Method". The M&TE No. for the carbon measurements is WC01713, the balance M&TE No. is 360-06-01-016. The data is located on the accompanying data sheets, review reports or on file in the ALO Records Office. TOC standard used is alpha-d-glucose, Kodak lot# B1F, and the TIC standard is reagent-grade Na_2CO_3. Both materials are used in liquid form, dissolved in water, for system standards as well as matrix spikes. Normal operation is with a TIC step first, using acid only, followed by the TOC step on the same sample, adding the persulfate. TC is calculated by addition. A modified mode was used in which TC was determined, eliminating the TIC step. This should minimize possible loss of any unmeasured volatile organics. The estimated precision is ±10% and the estimated accuracy is ±15%.

Part 2 of this work is done by the furnace total combustion method, Test Procedure PNL-ALO-380, rev. 0, "Determination of Carbon in Solids Using the Coulometrics Carbon Dioxide Coulometer". The M&TE No. for the carbon measurements is WD04981, the balance M&TE No. is 360-06-01-023. The data is located on the accompanying data sheets, review reports or on file in the ALO Records Office. TOC standard used is alpha-d-glucose and the TIC standard is $CaCO_3$. Both materials are used in solid form for system standards as well as matrix spikes. As per normal procedure, TOC is determined at 600°C on a sample. Then TC is determined at 1000°C on a different sample. TIC is calculated by difference. The estimated precision is ±10% and the estimated accuracy is ±15%.

QC Narrative: This sample was analyzed on 1-10-94. The QC for both methods all came within required MCS-033 limits, with no apparent outliers. For the

persulfate method, the TIC and TOC system standard recoveries ranged from 91.9% to 101.5%. The system blanks were consistent. The RPD's (Relative Percent Difference) for the dried sample, analyzed in duplicate, ranged from 3% to 10%. The matrix spike recoveries were 95% and 119%, respectively, for TIC and TOC, and 119% for the "crushed" sample TC spike.

For the furnace total combustion method, the TIC and TOC system standard recoveries ranged from 93.9% to 99.3%. The system blanks were consistent. The RPD's for the dried and as-received samples, analyzed in duplicate, ranged from 3% to 16%. The matrix spike recoveries, at 600°C, were 102% and 83%, respectively, for the dried and as-received samples.

Table 1: Hot Persulfate Method Results

Sample	sample wt (g)	TIC (%)	RPD (%)	TOC (%)	RPD (%)	TC (%)	RPD (%)
T-111 Dry-1	0.1304	0.41		0.94		1.35	
T-111 Dry-2	0.1857	0.42	3	1.04	10	1.46	8
				(avg=0.99%)		(avg=1.41%)	
T-111 Dry-3 Spike		95% TIC Recovery			119% TOC Recovery		
T-111 Dry-4 (crushed)	0.1638	0.52		1.74		2.25	
T-111 Dry-A (crushed)						1.90	
T-111 Dry-B (crushed)						2.09	10
				(avg=2.00%)			
T-111 Dry-C (crushed) Spike					119% TC Recovery		

Note: 1) Undissolved small black chunks of material were observed in reaction flask, indicating incomplete reaction.
2) The dried material was composed of large chunks, therefore it was crushed, in order to allow better dissolution. Improved dissolution was observed, but still black undissolved fines were seen.
3) Samples 1 through 4 were analyzed as per normal TIC/TOC procedure. Sample A through C were analyzed by modified TC procedure. In this case, the persulfate and acid were added at the same time to the sample, deleting the TIC step, minimizing possibility of loss of volatile organic material.

Table 2: Furnace Method Results

Sample	sample wt (g)	TIC (%)	RPD (%)	TOC (%)	RPD (%)	TC (%)	RPD (%)
T-111 Dry-1 (600°C)	0.01495			3.76			
T-111 Dry-2	0.01864			4.41	16		
T-111 Dry-3, Spike	0.02345	102% Recovery		(avg=4.09%)			
T-111 Dry-1 (1000°C)	0.03158					4.69	
T-111 Dry-2	0.02333					4.99	6.2
						(avg=4.84%)	
T-111 As-Recd-1 (600°C)	0.04890			0.90			
T-111 As-Recd-2	0.10883			0.87	3.4		
T-111 As-Recd-3, Spike	0.09272	83% Recovery		(avg=0.89%)			
T-111 As-Recd-1 (1000°C)	0.04227					0.98	

Note: 1) In the furnace method, TOC only is considered to be released at 600°C. At 1000°C, TC is considered to be released. Note that different weighed samples are used at the two different temperatures.

CONCLUSIONS:

1) The Hot Persulfate method alone provides one conclusion, that there is no loss of volatile organic material in the TIC step. The results appear to agree well with the earlier reported "as-received" sample results, after accounting for the water weight loss.

2) The Furnace method results, in comparison, indicate that there is additional organic material present in these samples. This additional organic material was, for some reason, not fully oxidized by hot persulfate, but required oxidizing with some stronger oxidant, (e.i., oxygen) at elevated temperatures.

3 In the dry material, from the Furnace method, the total TOC found was 4.09%, the total TC found was 4.84%. This compares, from the hot persulfate method, with total TOC found of 0.99% and total TC found

of 2.0%. Both method results show good agreement between "dried" and "As-Recieved" results, after accounting for water weight loss.

4) The missing, additional organic material, in the dried s e, amounts to:

TC comparison: (4.84% - 2.00%) = 2.8%
TOC comparison (4.09% - 0.99%) = 3.1%

Concur by: MC Bunt Date: 1/14/94
File: T-111.RMB
System File: TOC 11094

DON'T SAY IT --- *Write It!*

DATE: June 9, 1994

TO: Distribution

FROM: C. H. Delegard

Telephone: 373-4658

SUBJECT: CENTIFUGATION AND ANALYSES OF SLUDGE FROM TANK 241-T-111

Attached please find Internal Memo 8E110-PCL94-046, "Centrifugation and Analyses of Sludge From Tank 241-T-111." The attached IM provides recent thermal analyses of the centrifuged sludge and completes the reporting of the tank 111-T centrifugation tests. The attached IM replaces IM 8E110-PCL94-043, same subject. Please discard the IM 8E110-PCL94-043.

Westinghouse Hanford Company — **Internal Memo**

From: Process Chemistry Laboratories — 8E110-PCL94-046
Phone: 373-4658 T6-09
Date: June 9, 1994
Subject: CENTRIFUGATION AND ANALYSIS OF SLUDGE FROM TANK 241-T-111

To: D. B. Engelman T-49

cc:

H. Babad	R2-78
G. S. Barney	T5-12
D. R. Bratzel	R2-12
J. M. Frye	T6-30
J. R. Jewett	T6-09
J. G. Kristofzski	T6-06
L. M. Sasaki	R2-12
C. S. Simmons	K6-77
B. C. Simpson	R2-12
J. P. Sloughter	T6-07
C. S. Sutter	T5-12
D. T. Vladimiroff	R2-12
CHD File/LB	

References:

(1) Internal Memo, G. S. Barney and C. H. Delegard to D. B. Engelman, "Test Plan for Centrifuge Drainage Tests of Tank 241-T-111 Sludge Samples," dated May 3, 1994.

(2) Internal Memo, G. S. Barney to D. W. Jeppson, "Results of Centrifuge Drainage Tests for Simulated Infarm-2 Ferrocyanide Sludge," dated March 28, 1994.

INTRODUCTION AND SUMMARY OF RESULTS

In Reference 1, a laboratory test procedure was described to determine the liquid retention capacity of sludge from tank 241-T-111 (111-T). The test procedure was based on a study, described in Reference 2, conducted to measure sludge drainage rates. In the present studies, tests were designed to simulate the drainage of interstitial liquid from the existing 14-foot (4.3 meter) overburden of sludge in 111-T should salt well pumping at the tank bottom take place.

Pressure-enhanced drainage was imposed in the laboratory by removing interstitial solution from samples of genuine sludge by filtration through coarse-frit glass in a centrifugal field of 500 times gravity (500 G). This field simulates the 4.3-meter sludge hydrostatic pressure at the tank bottom. The weights of liquids extracted and sludge retained were measured intermittently over a period of about five days. By knowing the water concentration of the original sludge and the expressed liquid, the amount of liquid remaining in the sludge cake could be determined and compared with

water contents of the sludge cake measured directly at the end of centrifugation.

Four sludge samples from 111-T were tested in duplicate by this procedure. Results showed the water content of the initial sludges ranged from about 69 to 80 weight percent (wt%). Centrifugation filtering produced compressed, but still damp, sludge materials and quantities of expressed liquid. The rate of liquid removal from the sludge cake was rapid in the initial hours of centrifugation and slowed considerably after two days' centrifugation. The water content of the sludges after two days' centrifuging ranged from 58 to 66 wt%; after five days, the water content decreased a further 1.6 wt% for each sludge on average.

The experiments and measurements performed to determine the solution retention of the centrifuged sludge samples are described in this report. Ancillary chemical and thermal analyses of the intact and separated sludge and solution fractions also are reported.

EXPERIMENTAL MATERIALS AND METHODS

Archive sludge samples taken in 1991 were used in these tests. The sample materials were derived from segments 3 and 7 of core 31 and from segments 1 and 7 from core 33. The segment numbering proceeds, in order, from top (segment 1) to bottom (segment 9) in 19-inch (0.5-m) increments corresponding to the length of the segments.

The experimental approach used in the centrifugation tests generally followed the methods described in reference 1. The experimental observations were recorded in notebook WHC N 656 1

Coarse-frit glass filters (40 to 60 μm pore size) fused into 1-cm diameter glass tubes (about 8 cm long) were used as the filtration medium. Samples of well-mixed sludge were introduced to the top of frit filter surface by plunger-type polyethylene thief samplers. Tare and gross weight measurements (± 0.00005 grams using a five-place balance) of the tubes before and after introduction of sample were obtained. The glass tubes were placed in screw-top polypropylene 50-mL capacity centrifuge tubes and reweighed. Sample weights ranged from about 1.8 to 3.4 grams. Most sample weights were about 2.3 grams.

The tubes with samples were spun in a centrifuge located in an open-face hood in the 222-S Laboratory at a target velocity of 1680 revolutions per minute (RPM). This velocity corresponded, at the 15.8 cm distance of the sludge from the axis of rotation, to a field of 500 G at the filter frit disc. Measurements of the rotational velocity of the centrifuge were obtained during the course of the experimentation using an optical tachometer. The nine velocity measurements ranged from 1617 to 1720 RPM (i.e., 464 to 524 G) and averaged 1684 RPM (501 G). The temperature within the centrifuge was about 1°C above ambient lab temperature. The lab temperature ranged from about 19 to 24°C during the experiments.

The centrifuge was stopped periodically, the glass tubes and centrifuge cones were weighed and the weights of centrifuged liquid and sludge were determined by difference. The liquid was sampled for analyses of water content, density, thermal behavior and concentration of total organic carbon (TOC). After 113 hours, the centrifugation was stopped and the sludge analyzed for water content and thermal behavior. Samples of the original sludge also were analyzed for water content and thermal behavior. Sludge water content was determined by weight loss on oven heating to constant weight at 116°C. For the water content determinations, original sludge material sample sizes were 1 to 2 g; about 0.2 to 0.5 g samples were used for the centrifuged sludge materials.

Densities of the original and centrifuged sludge were determined. The densities of original sludge were determined by weighing sludge samples into volume-calibrated graduated centrifuge tubes and noting the total sludge solution plus settled solids volume after centrifugation.

The compressed centrifuged sludges from the solution retention tests were not sufficiently plastic to slump in the volumetric centrifuge tubes used for density measurement. Therefore, the densities of the compressed sludge were determined via a displacement technique using an immiscible liquid of known density (*n*-hexane). Samples of the compressed sludge were added to a tare-weighed 5-mL volumetric flask, the flask reweighed, the flask filled to the mark with *n*-hexane, and the flask again reweighed. The volume of added *n*-hexane could be determined by weight and density. The volume and weight of compressed sludge then was calculated by difference and the sludge density calculated.

All chemical, physical and thermal analyses (except the water concentrations of the centrifuged sludges and the densities of the original and centrifuged sludges) were determined by 222-S Analytical Operations. The densities of the expressed liquids were determined by weighing known volumes of solution held in volume-calibrated pipets. The TOC concentrations were found by acidified sample pyrolysis followed by coulometric titration of the product carbon dioxide collected in a scrubber trap. Water content in the expressed solution was determined by weight loss of sample due to heating in an oven.

The thermal analyses included differential scanning calorimetry (DSC) and thermogravimetric analyses (TGA). All sludge and expressed solutions were analyzed by DSC/TGA. The DSC determined if a heat-producing (exothermic) event occurred. An example of an exothermic reaction would be the oxidation of organic carbon by nitrate. The TGA showed fractional weight changes (e.g., weight loss by water evaporation) as a function of increasing temperature. Thus water concentration values were obtained via TGA for all samples.

RESULTS AND DISCUSSION

All the original sludge samples were dark brown in color with a pasty but slightly gritty consistency. Sludge samples from the segment 1 and 3 archives showed no natural segregation whereas the segment 7 samples had about 10% supernatant solution. The entire contents of each archive sample

were mixed prior to drawing subsamples for testing. Subsampling from the same archive vials two days later showed separation of supernatant solution had recurred in the segment 7 samples but again no supernatant solution was found for the segment 1 and 3 samples. Centrifugation resulted in the drainage (through the glass frit filters) of yellow liquids from all sludge samples and the production of a sludge cake that was smaller both in height and diameter than the original sludge (i.e., the sludge compressed as well as shrunk away from the glass tube wall).

The water content of the centrifuged sludge was calculated by weight loss of the sludge as centrifugation proceeded, the water content of the original sludge, and the water content of the expressed liquid. The water content of the centrifuged sludge, after 113 hours' centrifugation at 500 G, was also determined directly via oven weight loss. The water content data, presented in the Figure, show the original sludge was about 80 wt% water for the segment 1 and 3 samples and about 74 wt% for the segment 7 samples taken near the tank bottom. Though the archive segment 7 samples had supernatant liquid while the segment 1 and 3 samples did not, the segment 7 samples had lower water content than the segment 1 and 3 samples.

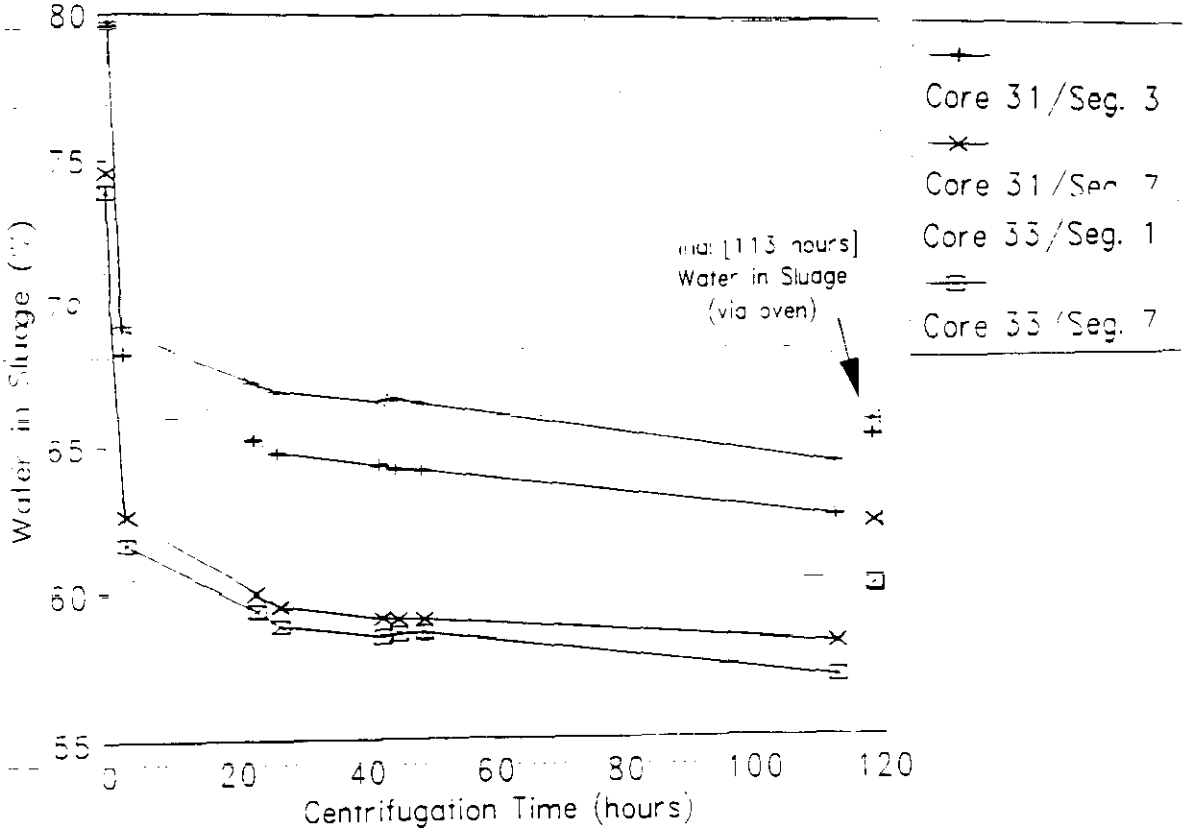

Figure. Water Concentration in Centrifuged 111-T Sludge.

The sludge samples lost solution (and water content) quickly in the initial three hours of centrifugation. The rate of weight loss decreased with time of centrifugation. After 113 hours, the water contents of the segment 1 and 3 samples were about 63 wt%; the segment 7 samples were about 58 wt%. The water contents of the centrifuged sludges determined by direct measurement of oven weight loss were about 65 wt% and 61 wt%, respectively.

The water content data of the individual replicate sludge samples are given in Table 1. The data show precision in the replicate measurements of about 0.5% relative or 0.8% absolute in the oven measurements and about 1.3% relative or 1.9% absolute for the calculated values based on the sludge weight losses. The oven values are about 2.8 ± 1.0% higher, on average, than the calculated values. The bias probably is due to the cumulative effects of water vapor loss from the centrifuged solution during each weighing operation. For this reason, the oven wt% water values are judged to be more reliable than the calculated values.

Table 1. Water Content of Sludge During Centrifugation.

Core/ Seg/ Dup	Centrifugation Time (hours)								
	0	3	23	26.5	42.5	45	49	113	113 (Oven)
31/3/1	79.54	68.6	65.8	65.4	64.7	64.5	64.6	63.0	65.14
31/3/2		67.7	64.4	63.9	63.6	63.5	63.4	61.5	64.78
31/7/1	74.52	63.1	60.6	60.2	59.7	59.8	59.8	59.1	62.28
31/7/2		62.0	59.2	58.7	58.3	58.2	58.2	57.1	61.83
33/1/1	79.71	68.7	67.1	66.8	66.4	66.5	66.3	64.4	65.74
33/1/2		69.3	67.0	66.7	66.3	66.4	66.2	63.8	65.23
33/7/1	73.87	61.8	59.9	59.4	59.1	59.2	59.3	57.3	59.66
33/7/2		61.3	58.8	58.2	57.7	57.8	57.8	56.6	60.23

The chemical and thermal analyses of the original sludge materials are summarized in Table 2. Exotherms were found for all sludge samples. The exotherms decreased as the sludge sampling depth increased (i.e., exotherms were greatest at the top). The wt% water values of the original sludge materials were determined both by weight loss, using 1 to 2 g samples heated to dryness in an oven, and by TGA, using 30 to 50 mg samples.

As shown in Table 2, the oven values for wt% water were higher than the TGA values. The values derived by oven weight loss are judged to be more reliable than the TGA values because they showed higher precision (better reproducibility in their duplicates), were obtained from larger, more representative samples, and thus were less subject to evaporative weight losses prior to initial weighing. The smaller TGA samples would be apt to lose more weight, on a relative basis, than the larger oven samples because they have a higher surface area to volume ratio. The oven-determined wt% water duplicate values for particular core/segment samples were averaged for

use in calculation of the water content of the corresponding centrifuged sludge.

Table 2. Analyses of the Original Sludge.

Core/Seg/Dup	Wt% Water		Density (g/mL)	Exotherm (J/g)
	Oven	TGA		
31/3/1	79.47	76.33	1.24	191
31/3/2	79.60	77.10		112
31/7/1	74.28	72.99	1.19	33.1
31/7/2	75.16	75.12		10.2
33/1/1	79.64	77.12	1.16	249
33/1/2	79.48	79.04		254
33/7/1	73.93	81.95	1.20	41.4
33/7/2	74.20	74.24		37.5

The chemical, physical and thermal analyses of the solution samples are summarized in Table 3. Though the samples (especially the segment 1 and 3 materials) contained organic carbon, no exotherm was noted in the DSC of any of the solutions. Again, both oven and TGA values of wt% water were determined and, for the same reasons, the oven values judged to be more reliable. The average value of the oven-determined wt% water duplicate analyses for particular core/segment samples was used to calculate the water content of the corresponding centrifuged sludge.

Table 3. Analyses of Expressed Solution.

Core/Seg/Dup	Wt% Water		Density (g/mL)	[TOC] (mg/L)
	Oven	TGA		
31/3/1	92.27	86.80	Insuff. sample	1620
31/3/2	91.65	85.13	1.040	979
31/7/1	88.87	80.80	1.065	210
31/7/2	88.52	85.40	1.087	140
33/1/1	95.41	87.02	0.990	1010
33/1/2	94.65	92.06	1.028	1000
33/7/1	90.02	85.50	1.089	180
33/7/2	89.44	86.66	1.101	200

The chemical and physical analyses of the centrifuged sludge samples are given in Table 4. The wt%s water derived from the TGA are significantly lower than those found by oven drying. Substantial air-drying of the centrifuged sludge apparently occurred prior to the TGA determinations. The DSC analyses showed that on a dry basis, centrifuged sludges had exotherms somewhat larger than the original sludges. For example, for sludge from

segment 1 of core 33 (which exhibited the highest exotherm of the four samples studied), the centrifuged material had an exotherm of about 1700 J/g dry sludge as compared to 1140 J/g dry sludge for the original material. For segment 3 of core 31, the centrifuged sludge gave about 1150 J/g dry sludge (the 1525 J/g value was not included in the calculation) while the original sludge gave about 640 J/g dry sludge. The centrifuged segment 7 samples showed no measurable exotherms; exotherms for the original segment 7 sludges were about 100 to 200 J/g dry sludge.

Table 4. Analyses of Centrifuged Sludge.

Core/Seg/Dup	Wt% Water		Density (g/mL)	Exotherm (J/g)
	Oven	TGA		
31/3/1	65.14	53.80	1.05	546.9, 465.3
31/3/2	64.78	56.92	1.12	1525.3, 544.9
31/7/1	62.28	58.94	1.16	0, 0
31/7/2	61.83	52.71	1.24	0
33/1/1	65.74	51.11	1.21	838.1
33/1/2	65.23	51.62	1.16	822.4
33/7/1	59.66	44.82	1.24	0
33/7/2	60.23	45.48	1.33	0

Please call should you have questions or comments on this work.

C. H. Delegard, Principle Senior Scientist
Process Chemistry Laboratories

am

SAMPLE STATUS REPORT FOR T 546. T-111 T-111 #1 TIME: 3/ 9/94 9:31
DISPATCHED: 3/ 5/94 10:31 SAMPLE HAS NOT BEEN SLURPED
RECEIVED: 3/ 5/94 13:15

EXT.	DETER.	RESULTS OR STATUS			OUT OF RANGE?	GOOD ANS?	CHARGE CODE
****	********	**********			***	***	******
1001	APPR/OTR	YELLOW CLEAR < 1% SOLIDS					N54D2
5706	SPG	1.03610E 00	NONE		N	Y	N54D2
5711	DSC	OUT FOR RERUN					N54D2
5711	DSC	INCOMPLETE					N54D2
5712	TGA	INCOMPLETE					N54D2
5713	pH	1.15700E 01	NONE		N	Y	N54D2
5714	% H2O	OUT FOR RERUN					N54D2
5714	% H2O	INCOMPLETE					N54D2
5720	TB	2.21000E-01	uCi/ML		N	Y	N54D2
5725	AT	2.31000E-03	uCi/ML		N	Y	N54D2
5726	TOC	4.73000E 02	uG C/ML		N	Y	N54D2
5727	TIC	8.00000E 02	uG C/ML		N	Y	N54D2
5728	NH4	3.61000E 02	uG/ML		N	Y	N54D2
5729	OH LIQ	3.54000E 03	uG/ML		N	Y	N54D2
5730	GEA	8.96000E-02	uCi/ML	Cs-137	N	Y	N54D2
5750	ICP-LIQ	2.04000E 04	uG/ML	Na	N	Y	N54D2
5750	ICP-LIQ	< 5.05000E 00	uG/ML	Al	N	Y	N54D2
5771	IC	1.95997E 03	uG/ML	F-	N	Y	N54D2
5771	IC	4.77260E 02	uG/ML	CL-	N	Y	N54D2
5771	IC	1.33501E 03	uG/ML	NO2-	N	Y	N54D2
5771	IC	2.91022E 04	uG/ML	NO3-	N	Y	N54D2
5771	IC	8.06644E 03	uG/ML	PO4-	N	Y	N54D2
5771	IC	2.78205E 03	uG/ML	SO4-	N	Y	N54D2
5778	CN LIQ	2.71000E 00	uG/ML		N	Y	N54D2
5781	Pu239/40	OUT FOR RERUN					N54D2
5781	Pu239/40	INCOMPLETE					N54D2
5782	Am241	< 3.97000E-05	uCi/ML		N	Y	N54D2
5783	Np237	< 1.38000E-05	uCi/ML		N	Y	N54D2
5786	Sr90	OUT FOR RERUN					N54D2
5786	Sr90	7.09000E-04	uCi/ML		N	Y	N54D2
9114	ARCHIVE	INCOMPLETE					N54D2

END OF REPORT

SAMPLE STATUS REPORT FOR T 548. T-111 T-111 #2 TIME: 3/ 9/94 9:32
DISPATCHED: 3/ 5/94 10:48 SAMPLE HAS NOT BEEN SLURPED
RECEIVED: 3/ 5/94 13:16

EXT.	DETER.	RESULTS OR STATUS		OUT OF RANGE?	GOOD ANS?	CHARGE CODE
****	********	**********		***	***	******
1001	APPR/OTR	CLEAR YELLOW < 1% SOLIDS				N54D2
5706	SPG	1.03760E 00 NONE		N	Y	N54D2
5711	DSC	OUT FOR RERUN				N54D2
5711	DSC	INCOMPLETE				N54D2
5712	TGA	INCOMPLETE				N54D2
5713	pH	1.15900E 01 NONE		N	Y	N54D2
5714	% H2O	9.29000E 01 % H2O		N	Y	N54D2
5720	TB	2.31000E-01 uCi/ML		N	Y	N54D2
5725	AT	2.32000E-03 uCi/ML		N	Y	N54D2
5726	TOC	4.18000E 02 uG C/ML		N	Y	N54D2
5727	TIC	7.90000E 02 uG C/ML		N	Y	N54D2
5728	NH4	3.70000E 02 uG/ML		N	Y	N54D2
5729	OH LIQ	2.70000E 03 uG/ML		N	Y	N54D2
5730	GEA	9.21999E-02 uCi/ML	Cs-137	N	Y	N54D2
5750	ICP-LIQ	2.43000E 04 uG/ML	Na	N	Y	N54D2
5750	ICP-LIQ	< 5.05000E 00 uG/ML	Al	N	Y	N54D2
5771	IC	2.15977E 03 uG/ML	F-	N	Y	N54D2
5771	IC	4.97640E 02 uG/ML	CL-	N	Y	N54D2
5771	IC	1.37823E 03 uG/ML	NO2-	N	Y	N54D2
5771	IC	3.00138E 04 uG/ML	NO3-	N	Y	N54D2
5771	IC	8.24791E 03 uG/ML	PO4-	N	Y	N54D2
5771	IC	2.85180E 03 uG/ML	SO4-	N	Y	N54D2
5778	CN LIQ	1.84000E 00 uG/ML		N	Y	N54D2
5781	Pu239/40	OUT FOR RERUN				N54D2
5781	Pu239/40	INCOMPLETE				N54D2
5782	Am241	< 2.76000E-05 uCi/ML		N	Y	N54D2
5783	Np237	< 2.89000E-05 uCi/ML		N	Y	N54D2
5786	Sr90	OUT FOR RERUN				N54D2
5786	Sr90	3.03000E-04 uCi/ML		N	Y	N54D2
9114	ARCHIVE	INCOMPLETE				N54D2

END OF REPORT

SAMPLE STATUS REPORT FOR T 550. T-111 T-111 #3 TIME: 3/ 9/94 9:32
DISPATCHED: 3/ 5/94 10:49 SAMPLE HAS NOT BEEN SLURPED
RECEIVED: 3/ 5/94 13:16

EXT.	DETER.	RESULTS OR STATUS			OUT OF RANGE?	GOOD ANS?	CHARGE CODE
****	********	**********			***	***	******
1001	APPR/OTR	CLEAR YELLOW < 1% SOLIDS					N54D2
5706	SPG	1.03310E 00	NONE		N	Y	N54D2
5711	DSC	OUT FOR RERUN					N54D2
5711	DSC	INCOMPLETE					N54D2
5712	TGA	INCOMPLETE					N54D2
5713	pH	1.17800E 01	NONE		N	Y	N54D2
5714	% H2O	9.29000E 01	% H2O		N	Y	N54D2
5720	TB	2.48000E-01	uCi/ML		N	Y	N54D2
5725	AT	2.49000E-03	uCi/ML		N	Y	N54D2
5726	TOC	3.80000E 02	uG C/ML		N	Y	N54D2
5727	TIC	OUT FOR RERUN					N54D2
5727	TIC	4.07000E 02	uG C/ML		N	Y	N54D2
5728	NH4	5.22000E 02	uG/ML		N	Y	N54D2
5729	OH LIQ	2.89000E 03	uG/ML		N	Y	N54D2
5730	GEA	8.78000E-02	uCi/ML	Cs-137	N	Y	N54D2
5750	ICP-LIQ	2.60000E 04	uG/ML	Na	N	Y	N54D2
5750	ICP-LIQ	< 5.05000E 00	uG/ML	Al	N	Y	N54D2
5771	IC	2.18774E 03	uG/ML	F-	N	Y	N54D2
5771	IC	5.11930E 02	uG/ML	CL-	N	Y	N54D2
5771	IC	1.40658E 03	uG/ML	NO2-	N	Y	N54D2
5771	IC	3.16720E 04	uG/ML	NO3-	N	Y	N54D2
5771	IC	8.83930E 03	uG/ML	PO4-	N	Y	N54D2
5771	IC	3.14581E 03	uG/ML	SO4-	N	Y	N54D2
5778	CN LIQ	2.39000E 00	uG/ML		N	Y	N54D2
5781	Pu239/40	OUT FOR RERUN					N54D2
5781	Pu239/40	INCOMPLETE					N54D2
5782	Am241	< 2.81000E-05	uCi/ML		N	Y	N54D2
5783	Np237	< 2.68000E-05	uCi/ML		N	Y	N54D2
5786	Sr90	OUT FOR RERUN					N54D2
5786	Sr90	1.21000E-03	uCi/ML		N	Y	N54D2
9114	ARCHIVE	INCOMPLETE					N54D2

END OF REPORT

Estimate of plutonium concentration that would place 241-T-111 out of specification with regard to established inventory limits.

50 kg $^{239/240}Pu$ is the standard inventory limit for single-shell tanks[1].

Therefore, $\frac{50{,}000\ g\ ^{239/240}Pu}{2.171E{+}09\ g\ waste} = \frac{2.303E{-}05\ g\ ^{239/240}Pu}{g\ waste}$

Approximate proportion of Pu-239 = 96%
Approximate proportion of Pu-240 = 4%

Specific activity of Pu-239 = 6.2E-02 Ci/g [2]
Specific activity of Pu-240 = 2.27E-01 Ci/g

Specific activity for the plutonium in the waste:
0.96*(6.2E-02 Ci/g) + .04*(2.27E-01 Ci/g) = 0.0686 Ci/g $^{239/240}Pu$

$$\frac{2.303E{-}05\ g\ ^{239/240}Pu}{g\ waste} * \frac{0.0686\ Ci}{g\ ^{239/240}Pu} * \frac{1E{+}06\ \mu Ci}{Ci} = \frac{1.58\ \mu Ci}{g\ waste}$$

The estimates of historical inventory values for selected analytes were derived from Agnew[3]. The estimates for 2C concentrations were done by taking the average concentrations of the two flowsheet formulations, 2C 44-51 and 2C 52-56. The 224 waste concentrations were used as presented. These values were multiplied by their respective volumes to develop the bulk inventory estimates. The buld concentrations presented for the tank were derived by multiplying each analyte's concentration by the fraction its waste contributes to the total inventory and adding them together, i.e. 0.526*($2C_{avg}$ concentration) + 0.474*(224 concentrations) = Bulk analyte concentration

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[1]Boyles, V. C. 1992, *Operating Specifications for Single-Shell Waste Storage Tanks*, OSD-T-151-00013, Rev. D-1, Westinghouse Hanford Company, Richland, Washington.

[2]Van Tuyl, H. H., 1962, *Fission Product Generation and Decay Calculations*, HW-75978, General Electric Company, Richland, Washington.

[3]Agnew, S. F. 1994, *Hanford Defined Wastes: Chemical and Radionuclide Compositions*, LA-UR-2657, Los Alamos National Laboratory, Los Alamos, New Mexico.

	MW 44-51	MW 52-56	1C44-51/CW	1C52-56/CW	2C44-51	2C52-56	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R', 52-56	R', 59-67	CWR/Al, 52-60
frac. prec. solid	MW		1C44-51/CW	1C52-56/CW	2C44-51	2C52-56	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R', 52-56	R', 59-67	CWR, 50-61
NaNO3	0	0	0	0	0	0	0	0.126	0.13546	0.13547	0	0	0	0.2805	0
NaNO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NaCl								0							
NaF	0	0	0.1706	0.1763	0.1058	0	0.3566		0.0634	0.06342		0.1639			
Na2CO3	0.1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Na3PO4	0.26873	0.2842	0.5587	0.5891	0.3119	0.0047	0	0	0	0	0	0.583	0	0	0
Na2SO4	0.46274	0.4741	0	0	0	0	0	0.1475	0.35513	0.35514	0	0	0	0	0
Na2SiO3	0	0	0.5024	0.5058	0.4683	0.231	1	1	0.43804	0.43805	1	0.4983	1	1	0.3509
Al2O3.3H2O	0.6	0.6	0.8	0.9	0.3	0.6	0.8	0.07	0.07	0.07	0.07	0.07	0.6	0.07	0.2
NaAlO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FeO(OH)	1	1	0.937	0.9374	0.918	0.8814	1	0.9337	0.85951	0.85951	1	0.9365	0.7404	0.8474	1
Cr(OH)3	1	1	0	0	0	0	0	1	1	1	1	0	0.5132	0.7165	1
MnO2	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
BiPO4	1	1	0.8987	0.8994	0.8525	0.7866	0.7587	1	0.88653	0.88653	1	0.8979	1	1	1
Pb(OH)2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
La2O3							0.6012								
Ce2O3							0.7								
Na3cit.5H2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Na Acetate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Na 2 Oxalate	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0
Na3HEDTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Na4EDTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CaCO3.6H2O	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ni(OH)2	1	1	1	1	1	1	1	1	1	0.29194	0.64	0.6569	1	1	1
ZrO(OH)2	1	1	0.2909	0.2957	1	1	1	1	1	1	1	0.2851	1	1	1
Na2NiFe(CN)6.6H2O			1	1	1	1	1	1	1	1	1	1	1	1	1
Pu	0	0.5	0	0.536	0	0	0	0	0	0	0.5	0.5291	0	0.2823	0.8964
UO2(OH)2*6H2O	0.75	0.75	0.9413	0.9811	0.9508	0.9289	0	0.49	0.49568	0.49569	0.4872	0.9808	0.1873	0.5599	0.7899
Cs	0	0	0	0	0	0	0	0.126	1	1	1	1	0	0.2805	0
Sr	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.6	0.6

pred. sludge ppm	MW	1C44-51/CW	1C52-56/CW	2C44-51	2C52-56	224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R', 52-56	R', 59-67	CWR, 50-61
Na	74421.3	84906	67763	91756	37520	85054	84503	108828	112478	59935	149106	27267	30241	39088
Al	0	26886	18384	0	0	0	0	0	0	0	0	80416	56395	95185
Fe	0	8261.2	5053.3	14346	21538	0	85341	17208.4	16707.7	14366	17854	2323.8	13519	0
Cr	0	47.505	66.147	31.335	31.029	35.236	0	0	0	0	19.034	12451	86255	0
Bi	0	13892	8542.2	20861	30102	20690	0	43576.4	49573.1	0	25403	0	0	0
La	0	0	0	0	0	26692	0	0	0	0	0	0	0	0
Ca	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZrO(OH)2	0	673.46	506.03	0	0	0	0	0	0	0	1051.7	0	0	0
Pb	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ni	0	0	0	0	0	0	0	5296.88	3929.25	24844	4711.7	0	0	0
Sr	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mn	0	0	0	0	0	190.28	0	0	0	0	0	0	0	0
Ca	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	0	0	0	0	0	7789.5	0	0	0	0	0	0	0	0
balance														
density	1.48011	1.3952	1.2648	1.2672	1.1383	1.2323	1.5282	1.49782	1.52137	1.3884	1.5943	1.5334	1.9841	1.7142
vol%solids	12	13.7	24.9	6.8	3.4	3.9	1.2	3.7	3.2	1.4	6.5	8.9	2.3	8.1
void frac.	0.5032	0.6026	0.7555	0.7506	0.9658	0.9251	0.5526	0.56193	0.49288	0.9942	0.2781	0.7056	0.6688	0.675
wt.% H2O	38.3486	65.494	73.61	70.904	81.073	68.962	30.449	32.8483	28.0527	81.568	57.788	56.029	38.078	51.253
TOC wt.%C	0	0	0	0	0	0.4152	0	0.64959	0.36973	1.8521	0.3474	0	0	0
free OH-	1413.58	28.312	73.634	193.87	218.81	468.48	60.802	152.367	67.4196	701.21	33.653	295.87	64.443	91.914
OH-	70327.2	59449	40478	13325	19938	468.46	99214	18341.8	21283.4	26242	17599	168648	220413	201774
NO3-	2241.47	14160	19717	42965	42545	61618	65015	67454.7	58250.4	102120	5673.5	67381	60603	20060
NO2-	0	3656.1	5090.7	0	0	0	0	0	0	5600.1	1431.2	0	0	26046
CO3—	31987.6	0	0	0	0	0	4363.5	0	0	0	0	0	0	0
PO4—	30383.9	95307	68622	86076	26565	12477	4488.6	24511.2	26594.1	8841.4	184824	0	0	0
SO4=	56474.6	2632.7	3665.8	2778.5	2751.3	0	112329	116969	131968	1100.7	1336.1	680.86	848.28	0
SiO3—	40.6213	3048.1	2049.7	5981.9	4834.6	0	0	7981.57	9028.17	0	5231	0	0	2350.8
F-	0	5507.9	4694	7386.1	2494.2	46554	0	5989.52	6428.09	0	7514.8	0	0	0
Cl-	0	0	0	0	0	0	296.26	0	0	0	0	0	0	0
C6H5O7—	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EDTA—	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	MW 44-51	MW 52-56	1C44-51/CW	1C52-56/CW	2C44-51	2C52-56	#224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R', 52-56	R', 59-67	CWR/Al, 52-60
HEDTA—	0		0	0	0	0	0	0	0	0	0	0	0	0	0
NTA—	0		0	0	0	0	0	0	0	0	0	0	0	0	0
glycolate-	0		0	0	0	0	0	0	0	0	0	0	0	0	0
acetate-	0		0	0	0	0	0	0	0	0	0	0	0	0	0
oxalate—	0		0	0	0	0	15227	0	0	0	0	0	0	0	0
TBP	0		0	0	0	0	0	0	0	0	0	0	0	0	0
NPH	0		0	0	0	0	0	0	0	0	0	0	0	0	0
CCl4	0		0	0	0	0	0	0	0	0	0	0	0	0	0
hexone	0		0	0	0	0	0	0	0	0	0	0	0	0	0
NiFe(CN)6—	0		0	0	0	0	0	0	24415.6	13896.8	69613	13057	0	0	0
Pu (µCi/g)	0.00476	0	0.0045	0.1247	0.0092	0.0112	0.0081	0.0018	0.00086	0.00076	0	0.3179	0.0102	0.273	1.837
U (µg/g)	164261		758.9	1475.8	210.68	321.82	0	49947	16963	19212.1	47220	4468.2	2003.7	26660	25473
Cs (µCi/g)	0.62888	0	5.6994	53.679	0.1038	0.2258	0	6.1105	7.1336	8.12054	1286.2	814.4	41.255	1761.9	1.3973
Sr (µCi/g)	52.661	0	0.3635	1.6658	0.3546	0.3188	0	188.65	29.4436	33.3497	0	4.2975	94.409	3466.5	14.487
prod. su. ppm	MW		1C44-51/CW	1C52-56/CW	2C44-51	2C52-56	#224	UR/TBP	PFeCN1	PFeCN2	TFeCN	1CFeCN	R', 52-56	R', 59-67	CWR, 50-61
Na	41131.1		33049	32786	41478	32592	31582	78745	75638	75556.1	60515	32694	53095	73406	71510
Al	0		1252.8	632.08	0	0	0	0	0	0	0	0	6454.4	23376	35088
Fe	0		105.23	105.46	104.12	105.75	0	97.166	97.6923	97.7268	0	105.68	100.05	91.354	0
Cr	0		103.63	104.57	49.285	34.608	44.511	0	0	0	0	103.24	1397.4	1278	0
Bi	0		295.33	295.99	292.23	296.8	297.34	0	274.174	274.271	0	296.6	0	0	0
La	0		0	0	0	0	790.29	0	0	0	0	0	0	0	0
Ce	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Zr	0		257.82	258.4	0	0	0	0	0	0	0	258.93	0	0	0
Pb	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Ni	0		0	0	0	0	0	0	0	92.4631	95.186	99.991	0	0	0
Sr	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Mn	0		0	0	0	0	240.37	0	0	0	0	0	0	0	0
Ca	0		0	0	0	0	0	0	0	0	0	0	0	0	0
K	0		0	0	0	0	9839.9	0	0	0	0	0	0	0	0
balance															
density	1.06901		1.0614	1.059	1.0733	1.0567	1.0545	1.1495	1.14291	1.1425	1.1102	1.0569	1.1161	1.2223	1.2643
vol%solids	12		13.7	24.9	6.8	3.4	3.9	1.2	3.7	3.2	1.4	6.5	8.9	2.3	8.1
void frac.	0.5032		0.6028	0.7555	0.7506	0.9658	0.9251	0.5526	0.56193	0.49288	0.9942	0.2781	0.7056	0.6688	0.675
wt.% H2O	89.3249		90.06	90.246	86.928	90.017	87.115	73.256	74.1115	74.141	98.76	99.415	79.053	69.708	71.7
TOC wt.%C	0		0	0	0	0	0.0514	0	0	0	0	0		0	0
species															
OH	3889.47		61.761	116.72	304.93	244.05	591.77	146.28	355.351	182.146	882.05	182.54	576.13	156.43	184.62
NO3	6167.45		30889	31170	67577	47453	77838	156414	157318	157374	128458	30774	131208	147105	40293
NO2	0		7975.4	8047.9	0	0	0	0	0	0	7044.5	7762.9	0	0	52316
CO3	32235.2		0	0	0	0	0	10498	0	0	0	0	0	0	0
PO4	12435.1		12586	12610	12479	12717	4019.1	10799	11104.9	11109.1	11122	12636	0	0	0
SO4	10781		5743	5795.2	4370.1	3068.7	0	10028	10082.2	10085.7	1384.5	7247.3	1325.8	2059.1	0
Si	111.77		529.29	530.46	523.73	531.92	0	0	491.374	491.548	0	531.56	0	0	444.37
F	0		3580.1	3588	3542.5	2782	3604.5	0	3323.64	3324.81	0	3595.5	0	0	0
Cl	0		0	0	0	0	0	712.76	0	0	0	0	0	0	0
C6H5O7	0		0	0	0	0	0	0	0	0	0	0	0	0	0
EDTA	0		0	0	0	0	0	0	0	0	0	0	0	0	0
HEDTA	0		0	0	0	0	0	0	0	0	0	0	0	0	0
NTA	0		0	0	0	0	0	0	0	0	0	0	0	0	0
glycolate	0		0	0	0	0	0	0	0	0	0	0	0	0	0
acetate	0		0	0	0	0	0	0	0	0	0	0	0	0	0
oxalate	0		0	0	0	0	1883.6	0	0	0	0	0	0	0	0
TBP	0		0	0	0	0	0	0	0	0	0	0	0	0	0
NPH	0		0	0	0	0	0	0	0	0	0	0	0	0	0
CCl4	0		0	0	0	0	0	0	0	0	0	0	0	0	0
hexone	0		0	0	0	0	0	0	0	0	0	0	0	0	0
NiFe(CN)6—	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Pu (µCi/L)															
U (M)															
Cs (Ci/L)															
Sr (Ci/L)															
B			10303					5605.5							
B'															
BY															
BY'															
A1															
A1'															
T1			10303					5605.5							

TANK 111-T STATUS

Liquid, Gal.	Sludge, Gal.	Sp. Gr. (g/cc)
82×10^3	430×10^3	1.032

Chemical Analyses

Free NaOH	0.701N
$CO_3^{=}$ (g/l)	
AlO_2 (g/l)	0.022
F^- (g/l)	
Cl^- (g/l)	15.8
Na^+ (g/l)	21.0
NO_3^- (g/l)	2.47
pH	9.5
CN^-	N.D.

Gamma Scan

$Zr\text{-}Nb^{95}$ (uc/l)	3.48×10^2
$Ru\text{-}Rh^{106}$ (uc/l)	1.21×10^3
Sb-125 (uc/l)	N.D.
Cs-134 (uc/l)	N.D.
Cs-137 (uc/l)	1.15×10^3

Boil-Down Studies

Percent Boil-Down	0	50	80	90
Boiling Point (°C)	105	105	106	107
Percent Solids -				
at boiling point	clr	clr	5	7
at room temperature	clr	clr	28	70

3-15-65

Atlantic Richfield Hanford Company

Date: June 7, 1974

To: R. L. Walser

From: R. E. Wheeler

Subject: ANALYSIS OF TANK FARM SAMPLES
SAMPLE: T-3304 111-T

Vis-OTR: Clear, Yellow, 30% solids like rust. Filtrate < 10 mrad/hr.

pH: 13.25

SpG: 1.018

OH: 0.254 M

Al: $< 6.48 \times 10^{-4}$ M

Na: 0.446

NO_2: 4.39×10^{-3} M

NO_3: 0.083 M

Pu: 1.17×10^{-6} g/l

DTA: No Exotherm

SO_4: 3.79×10^{-3} M

PO_4: 2.16×10^{-2} M

F: 3.56×10^{-2} M

CO_3: 0.024 M

GEA: ^{134}Cs - 1.13 µCi/gal
^{137}Cs - 3.69×10^{2} µCi/gal
^{125}Sb - 4.66 µCi/gal

Water: 98.24%

Cooling Curve: 10°C for 45 min. No solids.
5°C for 45 min. No solids.

30% Reduction - 27.5 Solids - 0
50% Reduction-50.0 Solids - 0.5%

REW:jd

Atlantic ...nfield Hanford Company

Date: September 24, 1974

To: R. L. Walser

From: R. E. Wheeler

Subject: ANALYSIS OF TANK FARM SAMPLES
SAMPLE: T-4893 111-T

Vis-OTR: Black. 90% solids. 10 mrad/hr, filtrate

pH: 12.9

SpG: 1.0202

OH: 0.206 M

Al: 7.75×10^{-4} M

Na: 0.188 M acm

NO_2: 5.17×10^{-3} M

NO_3: 0.109 M

Pu: $< 1.41 \times 10^{-6}$ g/l

DTA: No exotherm below 200°C

SO_4: 4.43×10^{-3} M

PO_4: 2.33×10^{-2} M

F: 4.28×10^{-2} M

CO_3: 6.59×10^{-3} M

GEA: ^{137}Cs - 5.72×10^{2} μCi/gal

Water: 98.46%

Cooling Curve: 40°C for 45 min. 90% Solids.
35°C for 45 min. 90% solids.
30°C for 45 min. 90% solids.
25°C for 45 min. 90% solids.
20°C for 45 min. 90% solids.
15°C for 45 min. 90% solids.
10°C for 45 min. 90% solids.
5°C for 45 min. 90% solids.

REWjd

cc: JR Christensen
JS Buckingham

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